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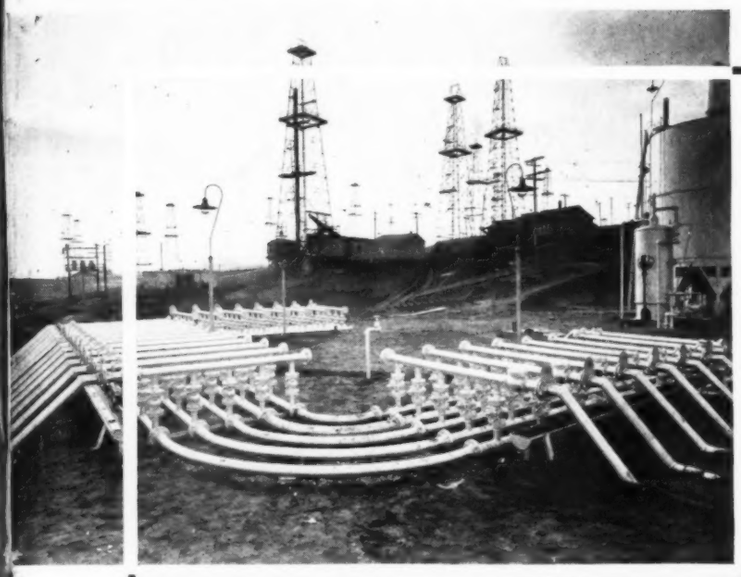


Only NORDSTROM VALVES meet every major valve need

Do ALL The Valves You Operate Meet These Requirements?

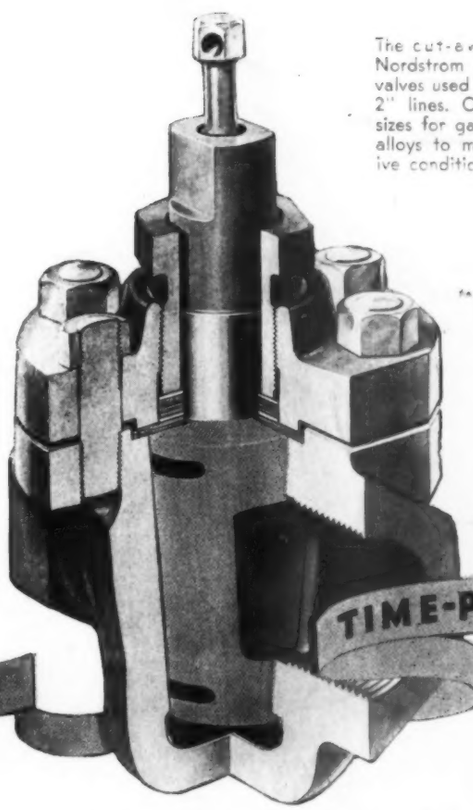
Leak-resistant?
Nordstroms are constantly sealed at the ports with lubricant under pressure, preventing leakage internally and externally.

Easy-turning?
Nordstroms have one moving part, the plug, completely surrounded by a film of lubricant. Non-sticking.

Quick-operating?
A quarter-turn completely opens or closes a Nordstrom, saving time at every turn.

Corrosion-resistant?
A wide variety of alloys is available in Nordstrom Valves to meet every condition of corrosion.

Compact?
Nordstroms are easiest to install, require no over-hanging stems or awkward yokes.



The cut-away view shows Nordstrom alloy steel plug valves used in high-pressure 2" lines. Other types and sizes for gas, up to 30", in alloys to meet any corrosive condition.

★

WORLD-WIDE ACCEPTANCE

TIME-PROVEN

MERCO NORDSTROM VALVE CO. *a Subsidiary of* PITTSBURGH EQUITABLE METER CO.
Main Offices: PITTSBURGH, PENNA.
Branch Offices: New York City, Buffalo, Philadelphia, Columbia, Memphis, Atlanta, Chicago, Kansas City, Tulsa, Houston, Los Angeles, Oakland.

TRET•O•LITE

PROCESS PATENTED — REG. U. S. PAT. OFF.

These Outstanding Features of Tretolite

Are responsible for its acceptance as a standard of comparison. Hundreds of installations throughout the oil fields attest to its constant efficiency in treating crude oil to pipe line requirements.

Tretolite Advisory Service is maintained to assist with treating problems. It is quickly available regardless of your location.

TRETOLITE COMPANY

MANUFACTURING CHEMISTS

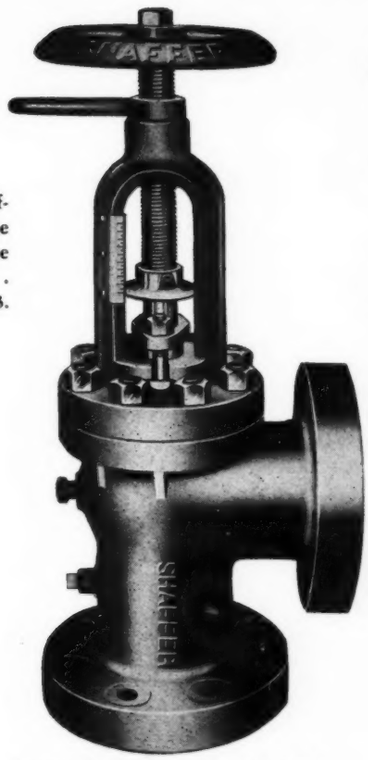
DALLAS — **SAINT LOUIS** — **LOS ANGELES**

Representatives in all Principal Fields

Faster Assembled & Better Christmas Trees

WITH NEW A.P.I. RING JOINT FLANGED SHAFFER FLOW BEANS

Write for the 1936 Shaffer Catalog or see the Shaffer Section in the Composite Catalog . . . It begins on page 1143.



Internal construction of A.P.I. Ring Joint Flanged Flow Beans is identical to Type 34.

COUNT THESE ADVANTAGES

1. FLANGED YOKE—Easy removal for renewing tip or backing out insert without disconnecting tee from flow lines or placing any strain on connections during renewal of parts.

2. A. P. I. RING JOINT FLANGES—Enabling Production Hookups to be built in less than half the time heretofore required. Tested to withstand pressures up to 6000 pounds per square inch. Eliminates the danger from poorly cut and leaky threads.

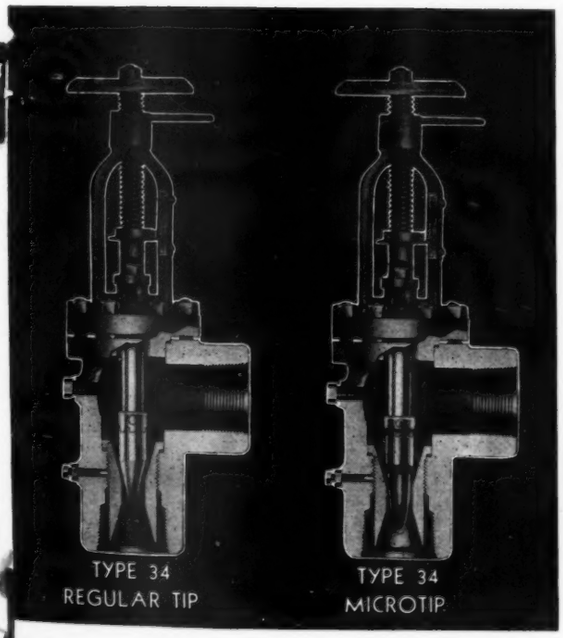
3. MICRO TIPS—Provides an equal increase in the opening area for each turn or fraction of a turn of the handwheel throughout the entire travel of the tip. Interchangeable with standard tips. Widely used for all kinds of close control of volume and pressure.

4. PATENTED REPLACEABLE VENTURI TUBES—Used in all Shaffer Adjustable Flow Beans. Allows the fluid to flow through smoothly and with minimum turbulence or tendency to emulsify.

SHAFFER TOOL WORKS

BREA, CALIFORNIA ★ HOUSTON, TEXAS

EXPORT—OIL WELL SUPPLY COMPANY



One of these . .
Shaffer Adjustable Flow Beans
. . . will meet your needs

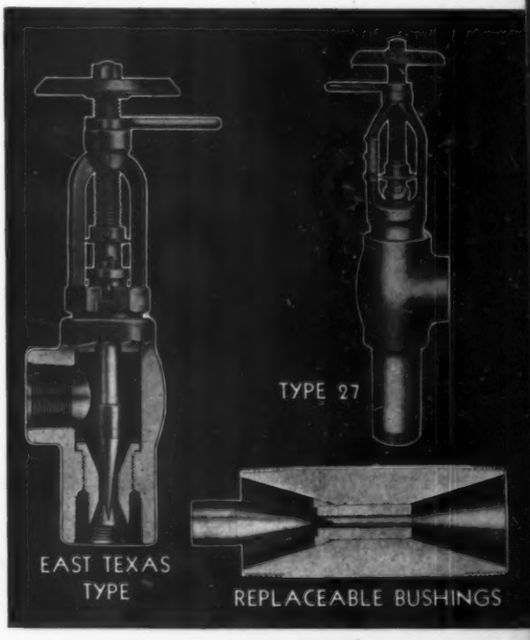
TYPE 34—REGULAR TIP—Yoke bolted to body. Screw ends. Tested to 6000 pounds per square inch.

TYPE 34—MICRO TIP—Provides equal increase in the diameter of opening for each turn of handwheel. Same internal construction as Type 34, except the tip.

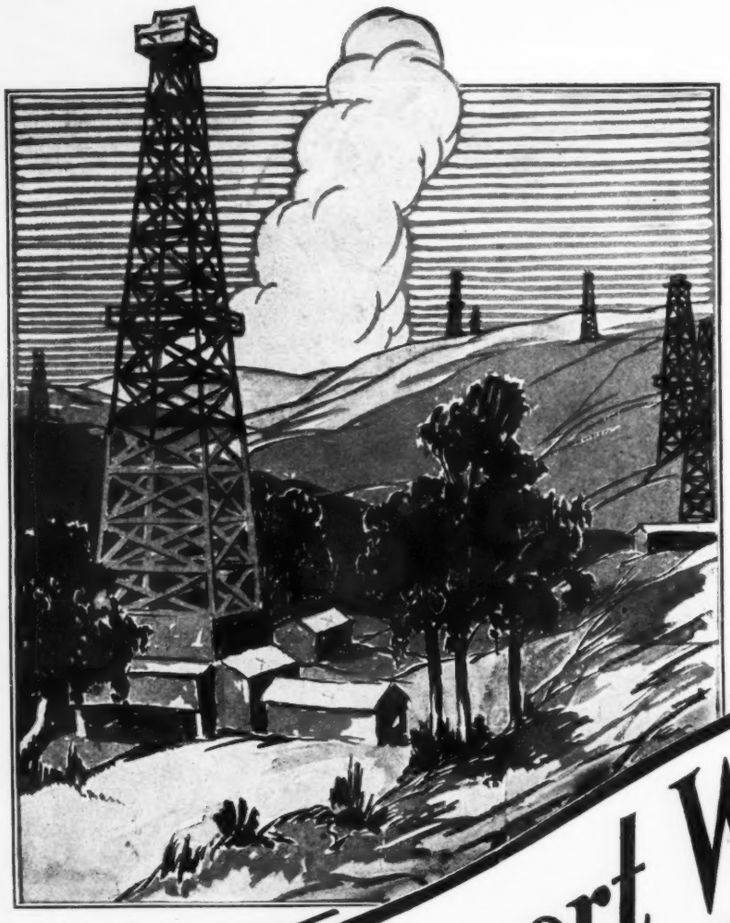
EAST TEXAS TYPE—Screw type yoke. Made for moderate pressure wells.

TYPE 27—Screw yoke. Solid drop forged steel tee. Made for pressures up to 6000 pounds per square inch.

REPLACEABLE BUSHINGS—Hard faced to resist abrasion. Recommended for holding back pressures on mud systems.



SHAFFER ADJUSTABLE FLOW BEANS



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the **Preference of Good Drillers** *Everywhere*

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The Petroleum Engineer, issued thirteen times a year by the Petroleum Engineer Publishing Co., 404-407 Tower Petroleum Bldg., Dallas, Texas. Subscription price, $2.00 per year, two years $3.00—25 cents a copy. Entered as second-class mail matter May 1, 1932, at the post office at Dallas, Texas, under the Act of March 3, 1879.

EAGLE DREADNAUGHT

For bearings subject to extreme speed and pressure, pounds, shocks, vibrations. Recommended for high-powered generators, motors, turbines, Diesel engines, oil, gas and gasoline engines, pumps, air compressors and equipment of similar nature, where service is severe. Withstands heavy pounding without cracking or distortion.

EAGLE OUTLASTA

For general all-round bearing requirements where constant or even pressure and speed prevail. Recommended for oil well, pipe line and refinery machinery.

EAGLE DURABLE

Replaces all miscellaneous "No. 4 babbitts." Made of good clean metal — properly alloyed. Free from impurities and dross.

3 Eagle BEARING METALS Fill 95% of all requirements

EAGLE BEARING SERVICE

In addition to these three regular bearing metals, Eagle-Picher has solved many difficult problems in connection with bearings subject to extraordinary service conditions. This service is available without charge. Call for advice or information.

OTHER EAGLE PRODUCTS USED IN THE OIL INDUSTRY • Eagle Lead Wool and Casings • Eagle Rope Socket Metal • Eagle Sheet Lead • Eagle Insulation • Eagle Sublimed Litharge • Eagle Sublimed Blue Lead

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FORMATIONS

OPERATING CONDITIONS

CORING REQUIREMENTS

Oil companies everywhere are standardizing on Elliott, the coring equipment that has made coring history in practically every field throughout the world for more than a decade. Now, one set of Elliott coring equipment with interchangeable soft and hard formation heads for ALL formations, assures the finest coring efficiency and performance at the lowest operating cost — with a minimum investment. Write for Bulletin No. 36-R giving detailed information.

ELLIOTT CORE DRILLING COMPANY
4731 East 52nd Drive, Los Angeles, California
Export Office: 420 Lexington Ave., New York City

ABOVE: Soft Formation Cutter-Head, for all soft and average formations.
RIGHT: Hard Formation Cutter-Head, for all formations from average to the hardest and toughest.

ELLIOTT *Combination* CORE DRILL

Pumping isn't the simple job it once was and correcting a troublesome pumping well takes more than just fishing for rods. You need to fish for facts also, if you want to know what to do about rod trouble and high pumping costs.

Let us help you. When we know the facts about the conditions that caused the rod trouble, then you can expect results. Fishing for facts means fewer rod breaks and lower pumping costs.

Tell us which is your most troublesome well and we'll demonstrate JoneSucke-Rod Service. It's thorough and complete—backed by sound engineering and 45 years' experience as the leading sucker rod manufacturers.

JONESUCKERODS

You asked for it.

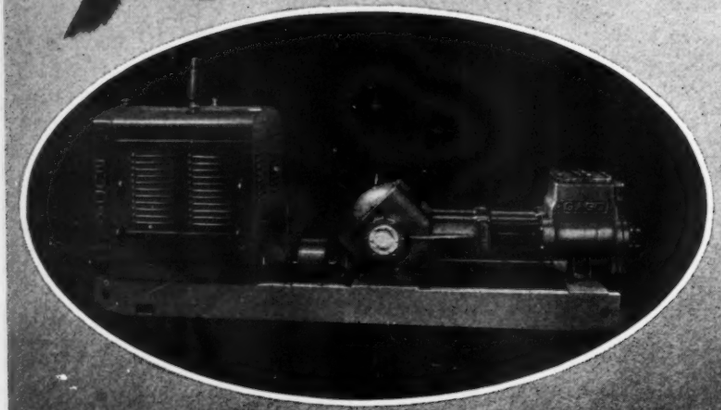


Fig. 2244 Gaso Duplex Enclosed Type Worm-Driven Power Pump—Capacities: 50 to 128 barrels at pressures of 650 to 350 lbs. . . . Worm drive of ground steel . . . Bronze ring gear and Timken Bearings.

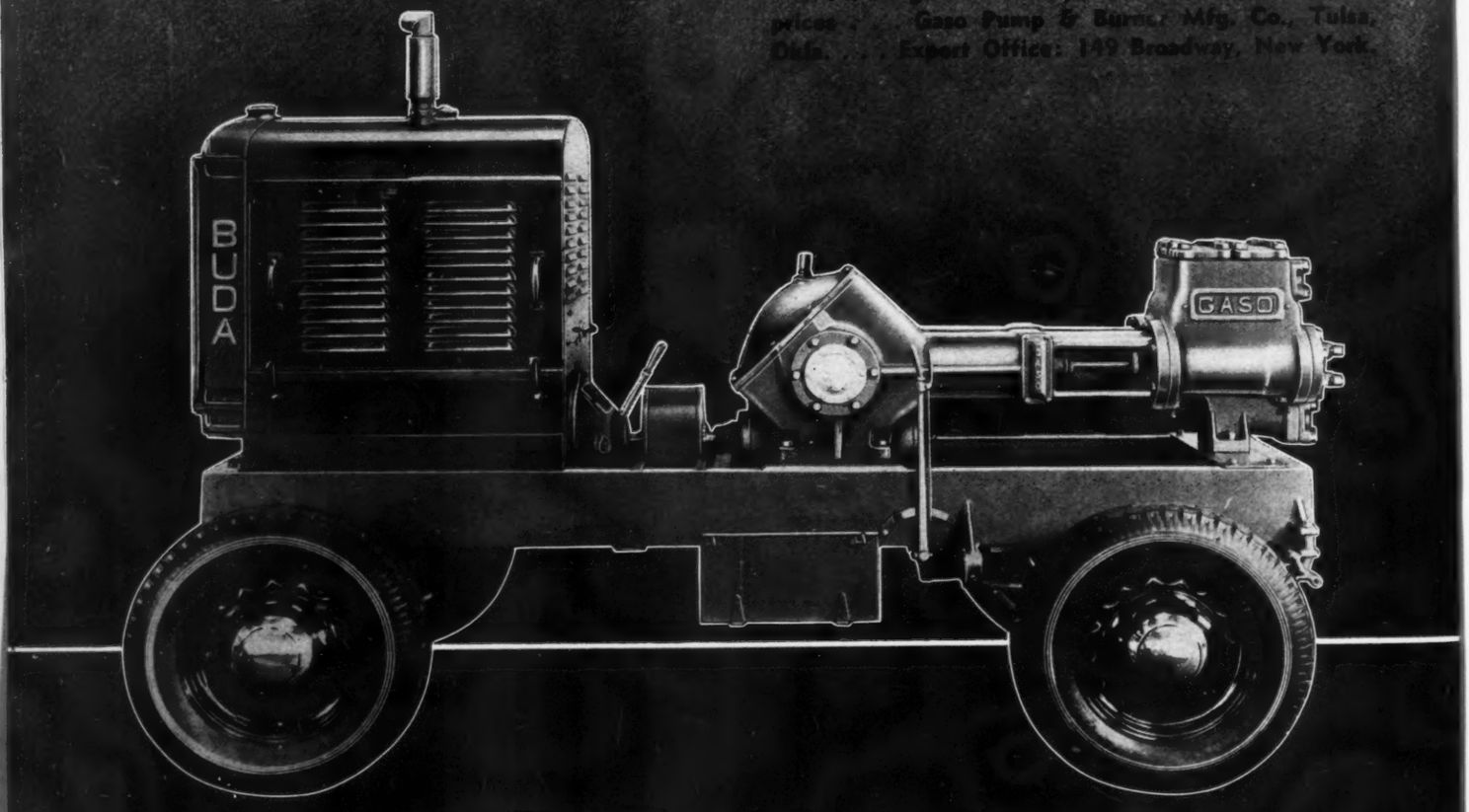
HERE IT IS!

The latest member of the Gaso family of pumps is of Gaso manufacture. But it is to you fellows in the industry that we owe its design.

You asked for a sturdy, general-service pump to meet certain specifications. You told us what duties the unit must perform—leaving to us the matter of incorporating into the pump traditional Gaso stamina, economy and durability.

In presenting the pumping unit shown on this page, we are merely meeting your demands.

We'll be glad to send you further details, with prices . . . Gaso Pump & Burner Mfg. Co., Tulsa, Okla. . . . Export Office: 149 Broadway, New York.



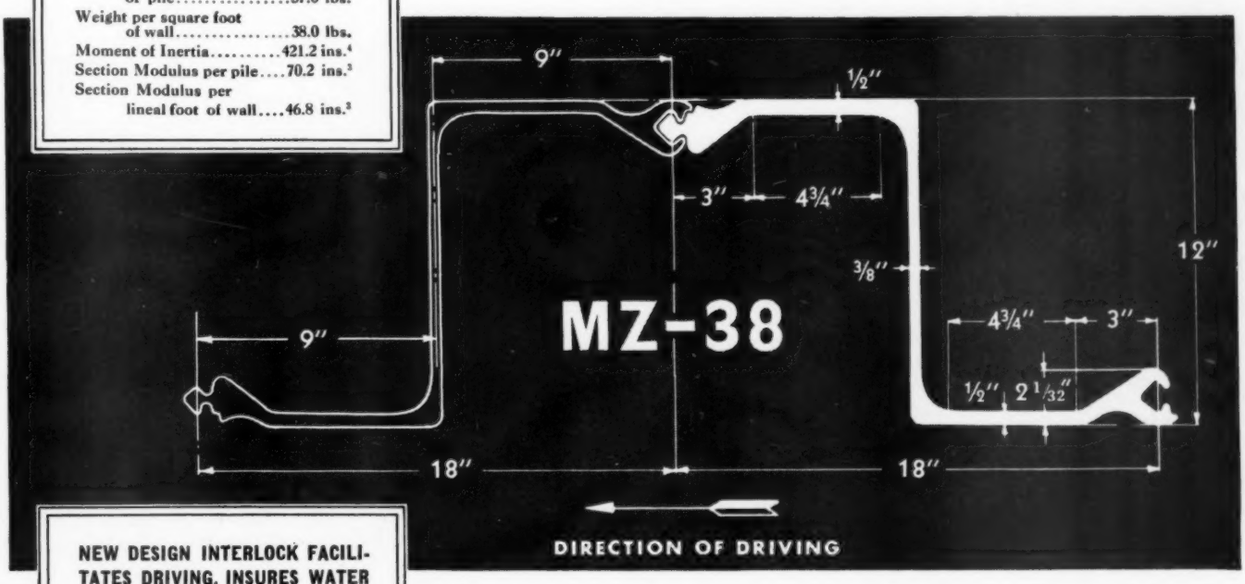
GASO PUMPS
for every oil industry need

CARNEGIE -ILLINOIS "Z" PILING

offering "Highest beam strength compared to weight"

COMPARE THESE SPECIFICATIONS

Area	16.77 ins.^{2}
Driving Distance	18.0 ins.
Weight per lineal foot of pile	57.0 lbs.
Weight per square foot of wall	38.0 lbs.
Moment of Inertia	421.2 ins.^{4}
Section Modulus per pile	70.2 ins.^{3}
Section Modulus per lineal foot of wall	46.8 ins.^{3}



NEW DESIGN INTERLOCK FACILITATES DRIVING, INSURES WATER TIGHTNESS, PRESERVES ALIGNMENT

In this improved ball-and-socket interlock, a triangular shaped ball with metal balanced both on ball and socket ends introduces a double locking feature which gives maximum water tightness, reduces tendency of piling to creep and twist in driving, minimizes swing in the interlock, helps to preserve alignment.

Further, the concentration of metal in the triangular-shaped ball greatly reinforces ball against curling during hard driving and facilitates the use of long sections in hard bottoms.

INTERLOCK WELDING UNNECESSARY

Interlocks are located where longitudinal shear is zero—the section modulus of the single uninterlocked pile is thus the same as when interlocked. No welding of interlocks is necessary to prevent slippage due to longitudinal shear.

RUGGED TO RESIST BATTERING

Note the heavy concentrations of metal at the four exposed points. They stiffen the pile against battering, make it especially suitable for deep water structures.

A new, more economical construction for oil docks, wharves and piers

IN introducing MZ-38—the first "Z" Piling to be rolled in this country — Carnegie - Illinois Steel Corporation offers you a Steel Sheet Piling having the highest beam strength for its weight ever developed.

Consider these figures: MZ-38 has section modulus per lineal foot of wall of 46.8 inches^3—yet weighs only 38 pounds per square foot of wall—57 pounds per lineal foot of pile. Because of its light-weight, heavy-duty character, MZ-38 is ideally suited to construction of oil docks, wharves, piers, bulkheads, sea walls and canal locks. For these and similar structures retaining heavy lateral loads over long spans, the economies of MZ-38 are obvious.

A sixteen-page addition to our Piling Catalogue, fully describing these new "Z" Piling sections, is now available. Be sure you get a copy. Our engineers are always ready to cooperate with you and will gladly furnish any further facts or figures you may need.

CARNEGIE-ILLINOIS STEEL CORPORATION

Pittsburgh — *Chicago*

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*

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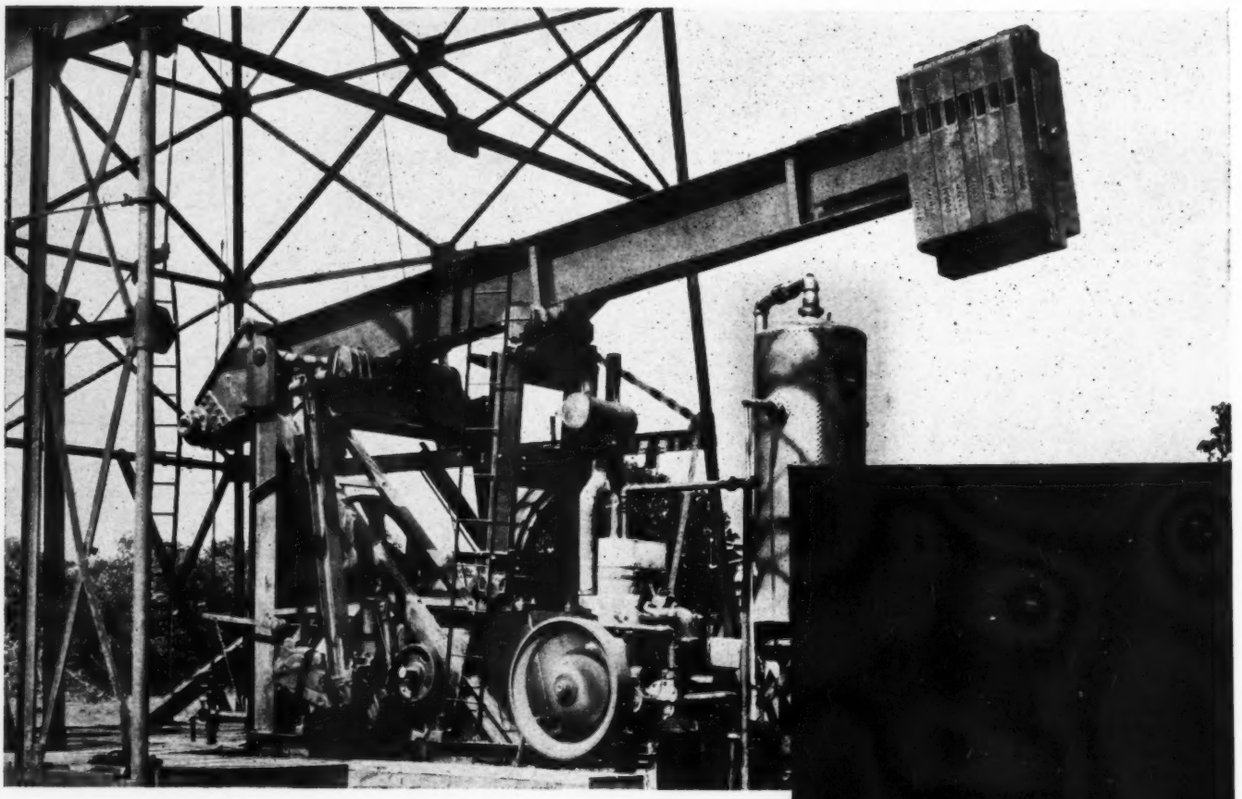
UNITED STATES STEEL



The performance record at the right was supplied by a Mid-Continent operator. It leaves no room for skepticism concerning the superiority of Parkersburg Long Stroke Pumping Units.

It is because of this tangible "dollar and cents" superiority that so many other operators are switching to Parkersburg Long Stroke Units. In every field the country over ... California, Texas, Louisiana, Oklahoma, Michigan ... their stories have been the same. More production at less cost per barrel.

Why not find out what a Long Stroke Unit will do for your wells? Make sure that you are not passing up a chance to increase your production by several hundred barrels per month. Your nearest Parkersburg representative will give you full details.

THE PARKERSBURG RIG & REEL COMPANY

PARKERSBURG, W. VA.

Dallas Houston Tulsa Los Angeles New York

BRANCHES IN ALL ACTIVE FIELDS

PARKERSBUR

PUMPING UNITS

Long Stroke

LEADING PIPE CUTTING SERVICE

SINCE 1921

OUTSIDE and INSIDE PIPE RECOVERY

J. S. Abercrombie Co.
21ST FLOOR GULF BLDG.
HOUSTON - TEXAS

A RED BALL CREW IS ALWAYS NEAR YOU

AFTER RUNNING YOUR FIRST STRING OF *Chester Special Casing* YOU BECOME A BOOSTER

Almost daily we receive reports from the field commending us on the fast running of *Chester Casing*. This is due to our accurate threading which tends to make a fast running and perfect joint.

Chester Casing **has a minimum of 40,000 pounds elastic limit — 70,000 pounds tensile per square inch and a hardness of 145 Brinell.**

A Few Reports That Come In

One hour's time saved in running string over other makes.

•

Customer said, "We are well pleased with the accurate threads."

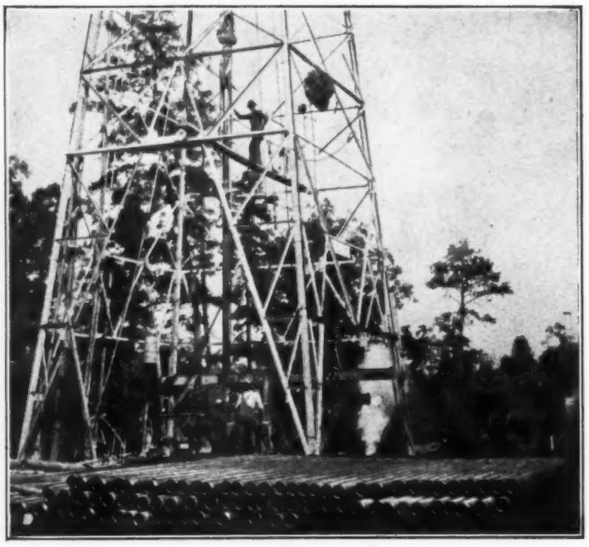
•

Not over a half thread variation in the whole string in making up.

•

Superintendent reported "The most perfect joints we ever ran."

•



A Few Reports That Come In

Another Tool Pusher said: "Am well pleased with it and it was a beautiful string."

•

Tool Pusher — "Never ran nicer Casing."

•

General Superintendent well pleased with reports from his field men regarding easy running of Chester Casing.

•

Another was skeptical — now a booster.

•

SOUTH CHESTER TUBE CO.
CHESTER, PENNSYLVANIA

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CHESTER
STEEL CASING AND LINE PIPE

HERE ARE THE 7

LINK-BELT DRILLING CHAINS

— use the one that fits your need

A Link-Belt Chain for Every Drilling Service	
Chain Number	Ultimate Strength, Pounds
SS-124, 3-Bar Hyper (API-4)	170,000
SS-124, 2-Bar Hyper (API-4)	130,000
SS-40 Hyper (API-3)	75,000
SS-40+ Red-Hed (API-3)	48,000
SS-124+ Red-Hed (API-4)	112,000
SS-40 (API-3)	28,000
SS-124 (API-4)	60,000
STOCKED IN ALL FIELDS	

● The ratings here given are one thing — but there is something else — another value that the experienced chain-maker builds into his product. Mere observation does not reveal it. Actual performance brings it out.

It is that something which belongs to the art of chain-making and which Link-Belt — chain-makers for over 60 years — has acquired through honestly trying to make the best chains that money can buy.

LINK-BELT COMPANY 5710

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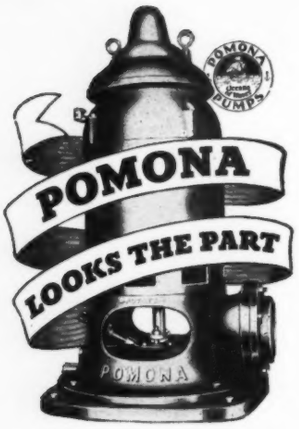
Export Sales Office: 2680 Woolworth Bldg., New York, U. S. A. Cable Address "LINKBELT"



Pomona Pumps have a big part to play in the world's production of water. In every civilized country on the globe, men are looking to Pomona for their water supply under every type of condition.

Here is a pump that has never failed them. Pomona's look of durability—of quality—of efficiency—has not been paint deep; it has taken abuse and over-work and kept right on building a reputation for long life—for low operating expense—for trouble-free operation. Pomonas look the part and justify every confidence placed in them by their makers and users.

Send today for a brand new bulletin featuring things you should know about hydraulic laboratory tests.

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POMONA TURBINE PUMPS

LIQUID LEVEL
and Flow in or Out
under positive remote control

VIGILANT
Liquid Level
REGULATOR

In the operation of Stills, Vaporizers, Bubble Towers, and Dephlegmators, a continuous inlet or outlet flow and a constant level of condensates can be definitely secured by installing a differential-type Vigilant Liquid Level Regulator on the side of the tank, and the control valve on the inlet or outlet line as required. Control works on compressed air, steam, water or gas. Bulletin No. 3113 on request.

THE CHAPLIN-FULTON MFG. CO.
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CONSTRUCTION COMPANY

RECONDITIONING
AND
OIL, GAS AND GASOLINE PIPE LINE CONSTRUCTION

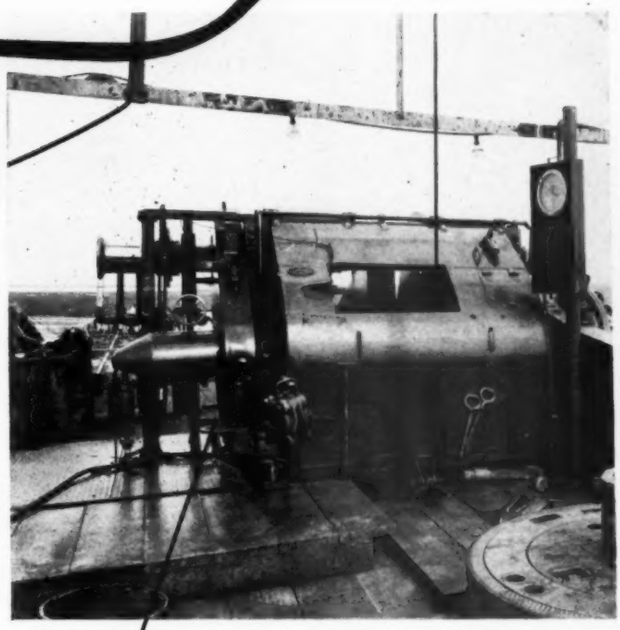
Twenty-five Years Experience

1903 Magnolia Building **Dallas, Texas**

Proven

WHERE THE DIGGING IS DEEP AND TOUGH!

DREADNAUGHT 360-Ton Capacity, 6-Sheave Straight Line Crown Block and 300-Ton Capacity, 5-Sheave Traveling Block on a deep well at Dickinson, Tex.



DREADNAUGHT No. 11 Unitary type, 3-Shaft, 4-Speed Draw-works digging a deep test at Bryan Mound, Brazioria County, Texas.

In the hard rock formations of Oklahoma . . . in the deep, tough gumbo and shale of the Texas and Louisiana Gulf Coast, DREADNAUGHT heavy duty Drilling Blocks and Draw-works have been definitely proven.

More hole in less time, at lower cost, in greater safety . . . that's our claim for these DREADNAUGHT products. We invite you to investigate them before you invest. Descriptive literature is yours for the asking.

BEAUMONT IRON WORKS CO.

BEAUMONT, TEXAS, U. S. A.

DREADNAUGHT

In every YOUNGSTOWN pipe-mill, staffs of inspectors, who operate in complete independence of the manufacturing department, constantly check and recheck each step in the manufacturing process. Their job is to make sure that every length of pipe is sound of weld, uniformly strong and ductile, and comes to you pressure-tested, free from flaws and cleanly and accurately threaded. Because they work so hard, your work is made easier.

THE YOUNGSTOWN SHEET AND TUBE COMPANY

Manufacturers of Carbon and Alloy Steels

General Offices - - YOUNGSTOWN, OHIO

Tubular Products; Sheets; Plates; Tin Plate; Bars; Rods; Wire; Nails; Conduit; Unions; Tie Plates and Spikes.

621

DRILL PIPE
CASING TUBING
LINE PIPE

The GREAT TIME SAVER

in the Oil Fields!

FOR CEMENTING

FOR BOTTOM-HOLE WORK . . . FOR SIDE TRACKING
FOR DERRICK CORNERS AND FOUNDATIONS . . . FOR
REPAIRING SPLIT CASINGS . . . FOR FILLING CREVASSES

TRINITY "HIGH EARLY STRENGTH" Portland Cement is always of uniform and dependable quality especially suited to oil well cementing. It produces an easy-to-pump mix that flows freely, but hardens quickly, assuring a dense, watertight, gastight job *hours sooner*. Yet it allows plenty of time for placement, even if you have a breakdown.

Above is a photograph of a well in East Texas taken just after it was cemented with TRINITY "HIGH EARLY STRENGTH" Portland Cement.

ASK FOR TRINITY "HIGH EARLY"

Trinity "HIGH EARLY STRENGTH" is a *true* Portland Cement—guaranteed to meet and exceed the Tentative Standard Specifications for High Early Strength Portland Cement of the American Society for Testing Materials, Designation C 74-30 T.

Use Trinity "HIGH EARLY STRENGTH" Portland Cement for oil well cementing and for *any* concrete construction where the saving of time is important. Three conveniently located plants assure prompt delivery. Call our nearest office . . . we will be glad to consult with you on your concrete problems.

TRINITY PORTLAND CEMENT COMPANY

Manufacturers of Trinity Standard Portland Cement, Trinity "HIGH EARLY STRENGTH" Portland Cement and Trinity Mix Masonry Cement

DALLAS · FT. WORTH · HOUSTON

THE *Lone Star*

1836 TEXAS 1936

SHINING 100 YEARS

BJ Triplex Hook

One hook for the swivel bail and a hook on either side for the elevator links eliminate off-center stress in BJ Triplex Hooks. All three of these hooks have "locking arms" which form "C" links and afford complete safety. One size is for 150-ton loads — the "300" is safe for the longest strings of drill pipe or casing.

BJ WELDLESS LINKS

Stronger than your derrick, BJ Weldless links are die cut from a single piece of steel. The large eye at top and Perfection Bend at bottom speed up operation.

BJ SIDE-DOOR SLIP ELEVATOR

Interlocking slips are automatically set by the casing collar, or at any desired point by a setting lever. The side door permits removal while cement is setting.

Vast oil fields, each presenting new drilling and production problems for solution, have made Texas the focal point for the development of new, stronger and more efficient oil tools. The BJ Triplex Hook, Weldless Links and the Side-Door Slip Elevator here illustrated are typical of the improved drilling equipment now used by progressive operators in the fields of Texas and the rest of the world. The safety, efficiency and advanced design of these and other BJ oil tools lend added effectiveness to the skill of drilling and production crews. They are saving time and money for the oil industry everywhere.

For full particulars concerning these and other modern BJ oil tools see pages 288 to 352 of your Composite Catalog, or write for the 1936 BJ Catalog.

BYRON JACKSON CO.

AND SUBSIDIARY

FORT WORTH • LOS ANGELES • NEW YORK

THE Petroleum Engineer

ALL-TEXAS NUMBER JULY 1

VOLUME VII

NUMBER X

A MAGAZINE OF METHODS FOR OPERATING MEN

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This All-Texas Number takes the date of the Midyear Review issue published each year on June 1. The Review that would have appeared in the Midyear Issue will be included in the regular issue later this year. "Regular Departments," omitted from this issue, will appear as usual in the regular issue of July 15.

Meetings

American Society for Testing Materials, Annual Meeting—June 29 to July 3, Chalfonte-Haddon Hall, Atlantic City, New Jersey.

•

California Natural Gasoline Association — July 2, Richfield Building, Los Angeles.

•

Interstate Oil Compact Commission —July 31, Dallas, Texas.

•

Michigan Oil and Gas Exposition—August 11, 12, 13, 14, 15, and 16, Mt. Pleasant, Michigan.

•

American Chemical Society, Semi-Annual Meeting—September 7, 8, 9, 10, 11, and 12, Pittsburgh, Pennsylvania.

•

World Power (Fuel) Conference—September 7, 8, 9, 10, 11, and 12, Washington, D. C.

•

National Safety Congress, Petroleum Section—October 5, 6, 7, 8, and 9, Atlantic City, New Jersey.

•

American Petroleum Institute, 17th Annual Meeting — November 9, 10, 11, and 12, Stevens Hotel, Chicago, Illinois.

•

Independent Petroleum Association of America, Annual Meeting—November 30-December 1, Biltmore Hotel, Oklahoma City, Oklahoma.

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Seventy Years of Oil in Texas
1866 . . . 1936

By K. C. SCLATER

THIS year, the year that Texas is celebrating its hundredth anniversary, marks the seventieth anniversary of the petroleum industry in the State. Recent investigation discloses that the first oil well was drilled near Nacogdoches in 1866—seventy years ago. This well was only 106 feet deep and although the production of crude obtained was unimportant commercially it is believed to mark the beginning of the petroleum industry in Texas. Later, in 1874, other wells were drilled in the vicinity of Nacogdoches and producing operations engaged in on a small scale.

It was not until some twenty years later, however, that the first substantial commercial production of petroleum was developed. This was at Corsicana in 1896-1897. Oil was first discovered there in 1895 in a well being drilled for water. The crude oil production developed having a very limited market, it led to the construction at Corsicana in 1898 of the first refinery in the State.

Petroleum was produced in Texas for fourteen years before it was recognized officially by State authorities, but these developments at Corsicana launched the petroleum industry in Texas firmly on its way. It was only a few years later, in 1901, that the first great gusher field in the United States was brought in at Spindletop near Beaumont.

During the thirty-five years that have passed since then the petroleum industry in Texas has increased by leaps and bounds. Its growth has been astounding. Today petroleum is the leading industry of Texas; besides, Texas now heads the list of oil-producing states by a wide margin. In 1935 more than 391 million barrels of oil were produced of which some 263 million barrels, or 67 percent, was refined within the State. The remaining one-third of the crude produced was transported by pipe line or tanker to twenty other States and to foreign countries.

Texas today is perhaps the most prolific petroleum-producing unit of any area on the globe; its approximately 62,000 oil wells supply 47 percent of the crude produced in the United States, or 18 percent of the crude produced in the world. The world's largest oil pool yet discovered, the East Texas field, is confined within its borders. It also leads in refining among the States and has the largest petroleum refining center in the world. Of the total crude production in the United States, 27 percent is refined in Texas at its 226 refineries, whose total combined daily capacity is between one million and one million and a quarter barrels.

This impressive leadership extends into the fields of natural gasoline and natural gas production. The natural gasoline yield of the State exceeds 400 billion gallons annually. There are some 128 gasoline plants whose total combined daily capacity is close to two and a half million gallons. Texas produces three times as much natural gas as California, the next highest ranking State in natural gas production. The largest known reserve of natural gas in the world is in the Texas Panhandle and underlies five counties.

Of the known twelve billion barrels of petroleum reserves in the United State, five and a half billion barrels are in Texas. It is estimated that there have been some 127,000 producing oil wells in Texas and of this number approximately 62,000 are producing today.

Texas also has an enviable record in contributions to the advancement of drilling equipment and methods.

Three of the most vital and far-reaching improvements in modern petroleum exploitation, the hydraulic rotary, the rock bit, and pressure drilling, were developed in Texas.

Unconsolidated sands and heaving shales so common to certain fields of the Gulf Coast, cause serious caving troubles and render drilling with cable tools well-nigh impossible. During development of the Spindletop pool, the first Coastal pool of its kind, this difficulty was immediately recognized. Its solution lay in the development of the hydraulic rotary method of drilling, which is a modification of the "water-flush" system used in 1881 at Pechelbronn, Alsace, oilfield in Europe. The hydraulic rotary method as developed at Spindletop was effective and met with immediate success.

For a number of years the hydraulic rotary method was limited to the drilling of soft formations; hard formations when encountered were hard to penetrate and proved formidable. This led to the development of the rock bit for drilling through hard formations. Today, the hydraulic rotary and the rock bit, both developed in Texas, are in universal use for drilling all types of hard formations.

Modern pressure-drilling methods were developed only a few years ago in the deep Big Lake field in West Texas. By means of this process deep wells in high-pressure areas now can be drilled-in under perfect control without injury to the producing sand and valuable information regarding the productivity of the well obtained before its completion.

The deepest hole yet drilled in the search for oil was that in Upton County, Texas. It reached a final depth of 12,786 feet in 1935.

Notable contributions have also been made to the advancement of modern petroleum production methods. Among these are the application of secondary recovery processes, particularly repressuring and pressure maintenance by injection or conservation of natural gas in flush fields. Successful pioneer projects of their kind, and widely recognized as such throughout the petroleum industry, are those of the Cook Ranch pool, the Sugarland field, and the Raccoon Bend field.

Petroleum has played a conspicuous role in the development of Texas since the turn of the century. As a natural resource its intensive exploitation has added enormously to the wealth and upbuilding of the State. Comparatively young as the petroleum industry is, its growth is closely bound up with the growth of the State as a whole. It therefore seems a fitting commemoration that this issue of The Petroleum Engineer be devoted to Texas and the development of the petroleum industry therein.

EDITOR'S NOTE: This All-Texas issue takes the date of the Midyear Review issue published each year on June 1. The Review for this year will be included in a regular issue later in the year.

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Texas Has Stirring History

By A. CAMERON

SOLDIERS, Indian chieftains, frontiersmen, Spanish cavaliers — all have played their significant role in the swiftly-changing history of early Texas. What is now known as Texas has grown from plains of undiscovered wealth to a flourishing leader in the nation of which it is now a part.

One of the first explorers attracted by the tales of fabulous riches was Cabeze de Vaca who, in 1528, historians tell us, carried back confirmation of these tales to the King of Spain after being shipwrecked on the coast of Texas. Francisco de Cornado left for the new world, and in 1541, before returning to Spain, claimed for his king the land that is now Texas.

France, too, had its claim on this new land. La Salle started from Montreal and sailed down to the mouth of the Mississippi River, claiming a large part of the New World in the name of the King of France. After returning to his homeland and being honored by King Louis XIV for his exploits La Salle again sailed for the New World, and, on February 18, 1685, he established the first white man's colony in Texas; having lost his way, he could not find the mouth of the Mississippi, but landed instead at what is now Matagorda Bay, Texas. Fort St. Louis was founded later in the same year. La Salle was treacherously killed by one of his followers over a petty argument, and was buried somewhere in Texas. When the Indians heard of La Salle's death, they led an attack on the fort and completely wiped out the white man's attempt at colonization.

Don Alonzo de Leon in 1689 led an expedition into Texas on the order of King Phillip II of Spain who had heard rumors of French colonization of the territory. Spanish priests followed de Leon and established missions in Texas that were later abandoned and presidios were built that served the double capacity of garrisons and missions. In 1714, Saint-Denis of France established a route for Indian trade, crossing the State of Texas; to offset this progress, Spain built presidios along the trade route. From this time until the end of the eighteenth century there were constant quarreling and rivalry between France and Spain over the rights of each in Texas. Peace was temporarily established in 1762 when France ceded Spain the territory of Louisiana that lay west of the Mississippi River. The province was receded to France in 1800, and in 1803, the United States purchased it for fifteen million dollars. This brought the Americans to the very frontiers of Texas despite the efforts of the Spanish to keep the Americans away from the territory.

During Mexico's revolt against Spain in 1812, adventurous Americans declared their intention of helping Mexico and Texas to free themselves from Spanish rule. Through these expeditions, Americans were introduced to the vast possibilities and resources of Texas, and from this time on, the acquisition of the Texas territory was the goal of many ambitious frontiersmen. Mexico finally struggled free from Spanish rule in 1821, and claimed all the territory of Spain in North America, including Texas, New Mexico, Arizona, California, and parts of Colorado, Utah, and Nevada.

American colonization of Texas began a year before Mexican independence, when Moses Austin went to San Antonio and directly asked the governor to let him bring three hundred families into the new territory. At first the governor flatly refused Austin's request, but was finally persuaded to send the petition to Spain for sanction by the proper authorities. Austin, having to be satisfied with this action, returned to his home in Missouri to await an answer. In 1821, death came to him, brought on by his long and arduous journey from Texas. A few days before his death, news came that his request had been granted. The son of Moses Austin, Stephen Fuller Austin, asked the governor of Mexico for permission to carry out his father's wishes. Permission was granted, and a place between the Colorado and Brazos rivers was chosen for the first American colony in Texas. After many hardships and set-backs, Austin built up the colony, and in 1824, asked permission to bring in another three hundred families. Mexico, after gaining her independence, felt a strong kinship with

Texas Hall of State, Texas Centennial Exposition, Dallas

the Americans who had freed herself from England, and the Mexicans extended a warm invitation to them to settle in Texas. Every married man was offered 4,428 acres, and anyone bringing in one hundred families was given 23,000 acres. American colonists, attracted by the liberal promises of Mexico, soon began to pour into Texas.

Most of the settlers were from Tennessee, Mississippi, Alabama, and Georgia. Wealthy planters, poor farmers, adventurers, lawyers, doctors, and merchants were found among the early settlers of Texas. In 1835, there was estimated to be between 25,000 and 30,000 Americans in Texas. Most of the colonists were farmers, and the principal crops were cotton and corn. At first, merchandise was hauled from New Orleans in heavy freight wagons pulled by oxen, but later it was taken up the Brazos River by steamboat. By 1834 the settlers were beginning to prosper. Sawmills, cotton gins, and mills for grinding corn had all sprung up. In New Orleans, the colonists exchanged cotton, corn, and animal skins for machinery, farming implements, household goods, flour, and coffee. Many of the beginnings of the large industries of Texas had their birth in this early period.

The colonists suffered unbelievable hardships at the beginning. Their homes were rude huts furnished with what they were able to bring on the backs of their horses or construct of logs and stones. Food was scarce, and they were forced to live on the game that roamed the prairies. They were constantly in dread of the Indians, who, without warning, would go on the warpath, massacring whole families and communities at a time. As the crops became more abundant and more families settled in Texas, conditions improved, and within the short space of fourteen years, the Americans had done more in the colonization of Texas than Spain had been able to accomplish in her three hundred years of possession.

The colonists concerned themselves little with the government in Mexico; their connection with the United States was closer than with Mexico. Most of them had relatives and friends in the United States and often went back to visit. Their trading was with the United States, and children were sent there to school. All these factors had special significance in paving the way for the Texas revolution in 1835.

Skirmishes between the Americans and Mexicans preceding the actual declaration of war, began as early as 1832. The basic cause of the revolution was the mutual mistrust in which the two races held each other. Mexico feared the loss of Texas to the Americans, and the Americans many times rose up in open rebellion against the harsh measures that Mexico felt justified in invoking to protect her interests in Texas. Encouraged by victory in one of the skirmishes with the Mexicans, the colonists decided to petition the government for a separate state organization for Texas, in preference to the union with Coahuila. They chose Stephen Austin to carry the petition together with a constitution for the new state that had been drawn up by General Sam Houston. The request of the Texans for separate statehood was refused, but the Mexicans promised to consider some of the suggested reforms. Austin started home, but due to a serious misunderstanding on the part of the Mexican government was seized and imprisoned for fifteen months. In 1832, the Texans had succeeded in driving most of the Mexican troops out of Texas so that in 1834 there were only three troops left in Texas, two in San Antonio and one in Goliad.

Austin returned home in the fall of 1835, and declared that war with Mexico was the only recourse and called for volunteers to march against Mexico. The Texans were eager to take up arms, and in 1835 the first shot of Texas' war of independence was fired in Gonzales. The Mexicans had been ordered to seize the cannon that the settlers had to protect themselves against the Indians. The colonists did what the Mexicans had feared—they turned the cannon on the troops, and the Mexicans fled in panic, thus the first battle ended in victory for the Americans. The Texans next captured the valuable military stores of the garrison at Goliad, where they easily overpowered the Mexicans.

There was now no uncertainty in the minds of the volunteers whether they should go to war, and in December, succeeded in taking San Antonio from General Cos. A serious quarrel brought about a dissolution of the provisional government that had been set up by the Texans at the beginning of the war, and a convention that met on March 1, 1836, declared Texas an independent republic, adopted a constitution, and elected David G. Burnet as temporary president.

General Santa Anna stormed the Alamo on Sunday, March 6. The Texans tried to hold the walls of the fort, but the odds were too great, and within an hour every defender of the Alamo lay dead. Less than three weeks after the fall of the Alamo, a small army of Texans under the command of Colonel Fannin, after being forced to surrender, were mercilessly massacred by Santa Anna's orders. The fall of the Alamo and the fate of Fannin's army fanned the anger of the Texans into white heat, and they were determined to avenge the death of their courageous

The HISTORY of Directional Drilling

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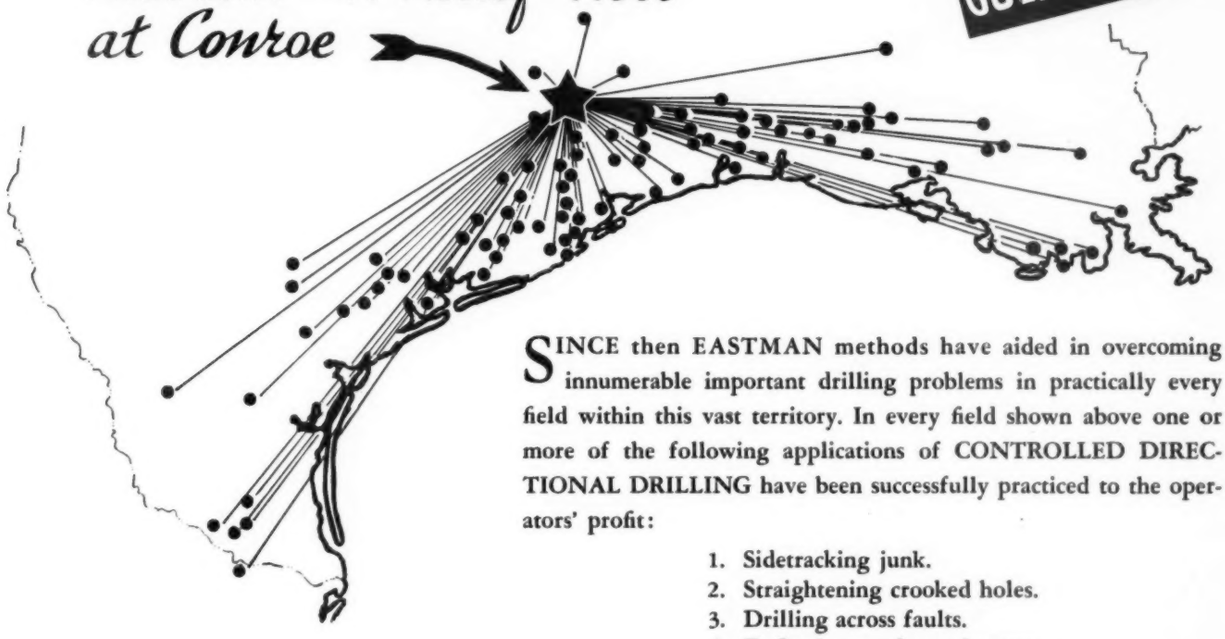

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friends. On April 21 General Houston and his men faced the Mexican army in the battle that was to decide the independence of Texas. At Houston's command of "Forward!" the Americans charged the Mexicans with the cry "Remember the Alamo!" The Mexicans, completely surprised, retreated within a few minutes. This, the battle of San Jacinto, brought to a close Texas' long struggle for independence.

Santa Anna escaped, but was captured the next day, and on May 14, President Burnet and Santa Anna signed the Treaty of Velasco, providing for the retreat of the Mexican army beyond the Rio Grande. By terms of the treaty the Mexicans had to restore or pay for all the private property taken from the Americans, and Santa Anna was to be released and sent back to Mexico where he was to influence the government in recognizing the independence of Texas. The American soldiers refused to allow Santa Anna to return to his own country, and forced President Burnet to order his arrest. Santa Anna was not freed until February, 1837.

After the Battle of San Jacinto the settlers returned to rebuild their ravaged homes. On September 1, 1836, they approved the constitution formerly adopted by the convention, and elected General Houston as president of the republic. Since the constitution declared that no one could hold office for two successive terms, Houston, despite his excellent fulfillment of duties, was succeeded by President Lamar. Houston was again elected in 1841.

Although there were hard times and danger from the Indians, the population in Texas increased. The capital was established in Austin, and provision made for public free schools. The United States recognized the independence of Texas in 1837, but England hesitated to recognize the freedom of Texas, fearing that if Mexico lost Texas she would be unable to pay debts to English subjects. Mexico refused to give up its claim on Texas although no fighting continued after 1843. During all this time, Texas wished to become a part of the United States, but the United States refused her admittance, fearing warfare with Mexico. Later, however, it was the United States that proposed annexation, and on February 16, 1836, the flag of the Texas Republic was replaced by the stars and stripes.

The admission of Texas into the Union brought to a crisis the issue of Texas' independence, which Mexico refused to recognize. The Mexican government immediately broke off diplomatic relations with the United States. The war that followed ended victoriously for the Americans with the treaty of Guadalupe Hidalgo in February, 1848. By this treaty the United States acquired a vast territory in the West, and the Rio Grande was the recognized boundary between Texas and Mexico.

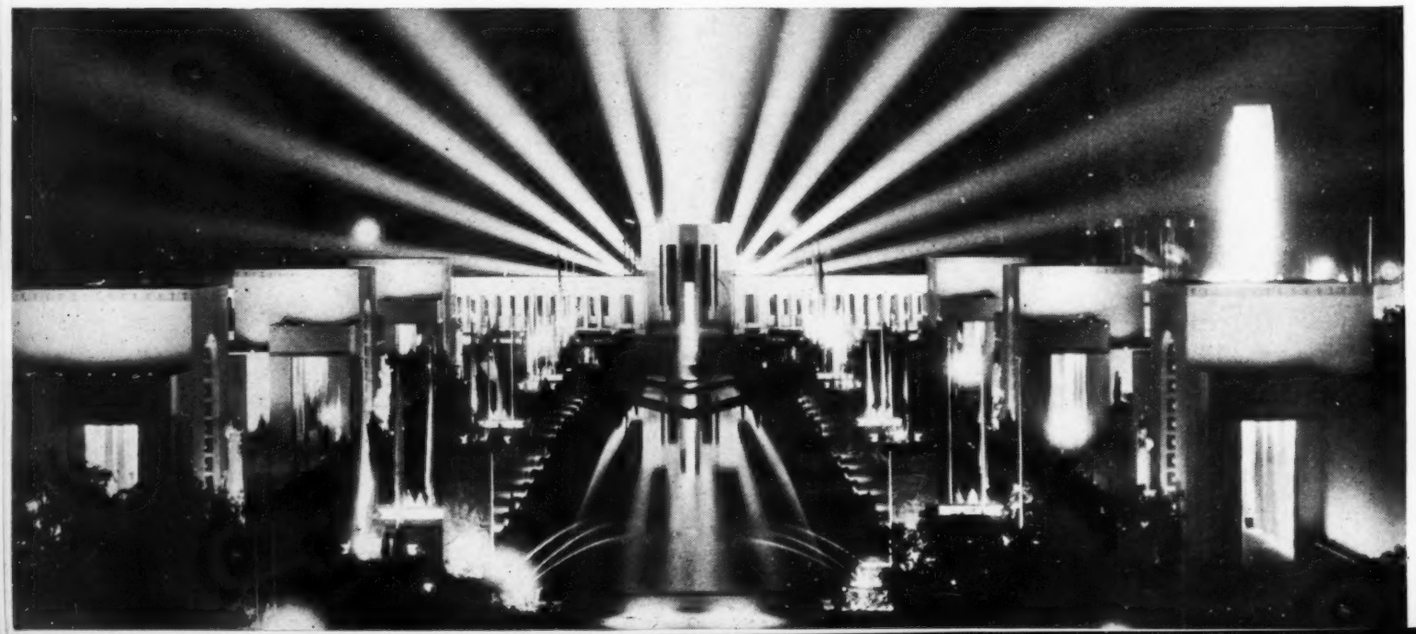
January 28, 1861, witnessed Texas' secession from the Union against the wishes of Governor Houston. Although many Texans took part in the Civil War, Texas was not the active scene of major conflict.

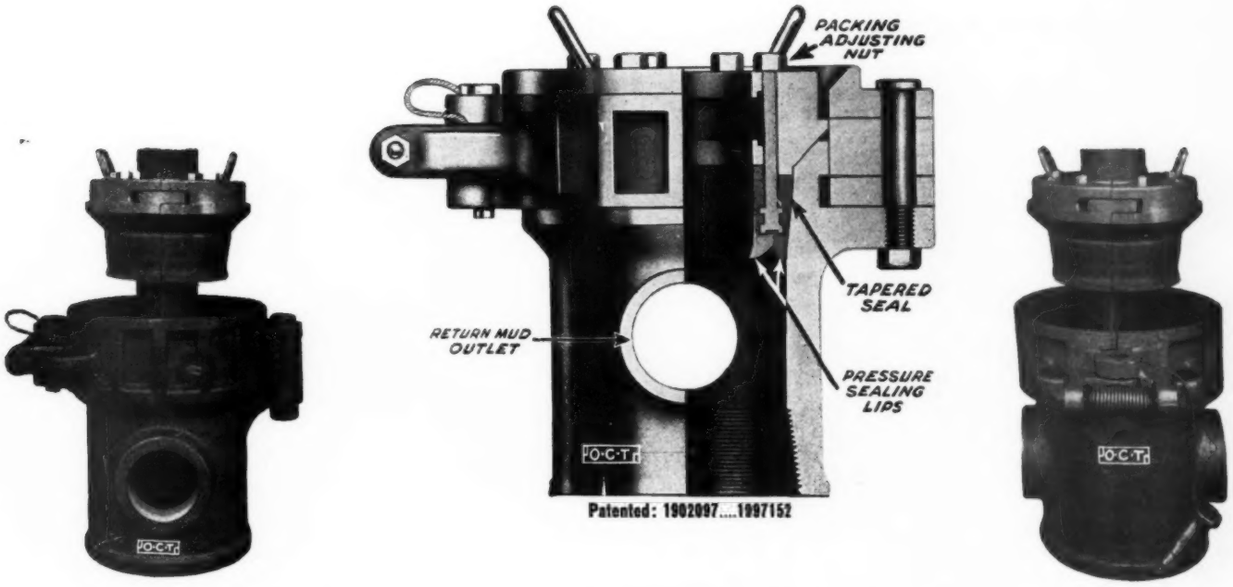
After the close of the war in 1865, the Federals, as the Union soldiers were called, took possession of Texas and declared the slaves free. Having ratified the Thirteenth, Fourteenth, and Fifteenth Amendments to the Federal Constitution, Texas was readmitted to the Union by act of Congress, March 30, 1870. After 1874, the people were again in control and rapid recovery was made. Immigrants poured into Texas from the war-stricken States. Railroad building reached boom proportions. From that time forward the progress of the State has been sturdy and continuous. On February 15, 1876, the present constitution was ratified by the people.

It is impossible to fix a date when actual industrialization of Texas began. Manufacturing started among the first white settlers. Mills for grinding corn and wheat were built, and manufacture of lumber began at an early date. The building of a connected system of railroads began in 1872 and opened the way for industrial development. It was not until the beginning of the present century, however, that the manufacturing industry became a prominent part of Texas' economic development.

Not only has the petroleum industry given Texas the raw material for the greatest of its manufacturing industries, but it has assured to other manufacturing industries an ample fuel supply and has contributed much to the building of industries dependent on petroleum by-products. Manufacture of cotton goods, cottonseed products, and flour also developed rapidly after the turn of the century. Two large packing plants built in Ft. Worth in 1901 launched Texas into the meat-packing industry. The beginning of the twentieth century heralds a new chapter in the industry of Texas. The last thirty-six years have been characterized by a phenomenal growth including the rise of cities, development of foreign trade, great progress in both public schools and higher education, the building of a connected highway system, and the beginning of the development of the artistic resources among the people.

Night Scene—Esplanade of State, Texas Centennial Exposition, Dallas





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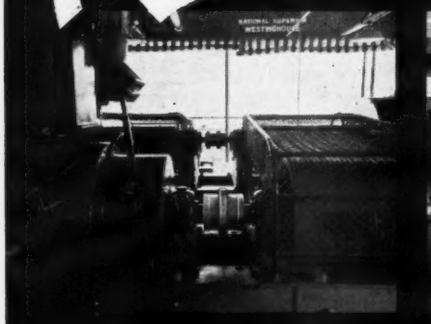


Exhibit of National - Superior - Westinghouse

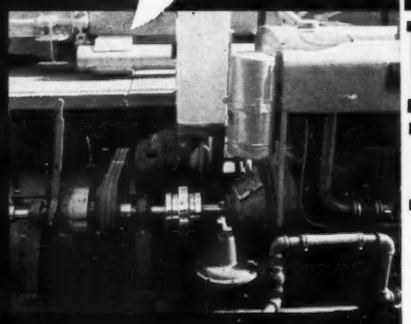


Exhibit of Portable Rig Company

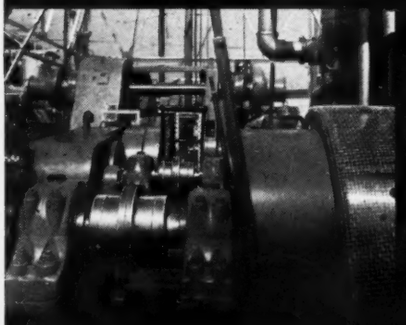


Exhibit of National Supply Company

Exhibit of Cummins - Allis Chalmers
Mid-Continent Supply Co.

Exhibit of Atlas Imperial Deisel Engine Co.

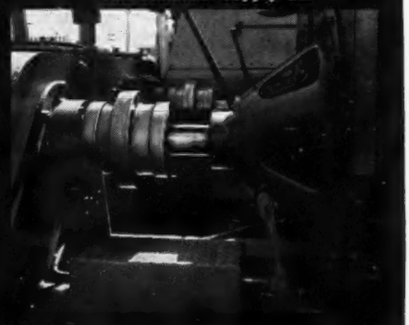
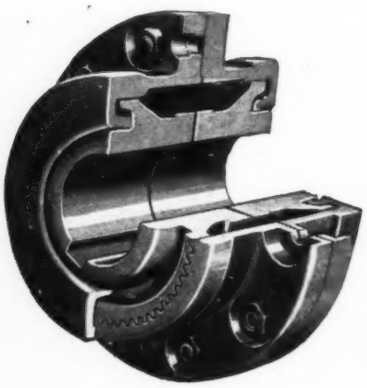


Exhibit of Portable Rig Company

EXHIBITORS at the Tulsa Oil Show display Fast's Self-Aligning Couplings as standard equipment on their machinery.



THE illustration above shows Fast's construction. No perishable materials are necessary to make it dust and moisture proof.

FAST'S PATENTS COVER THESE VITAL FEATURES

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Petroleum Engineering Education
Needs as Provided by the State

THE UNIVERSITY OF TEXAS

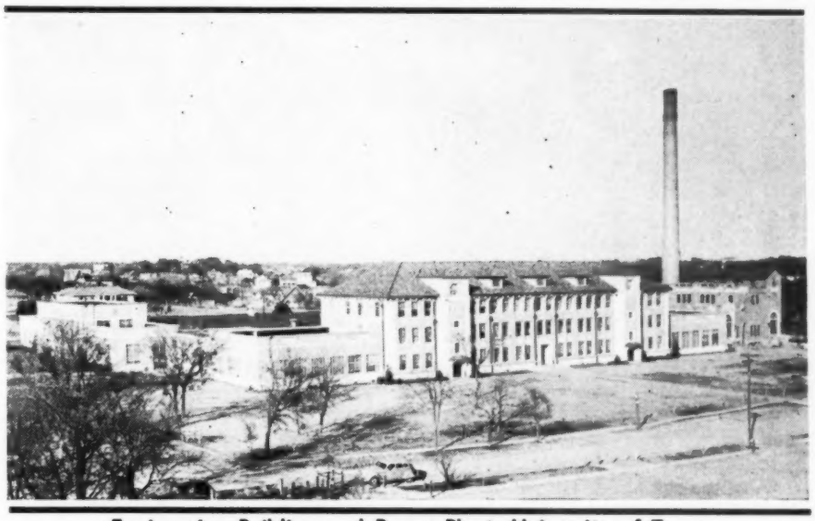
By W. D. HORNADAY

WHEN the forefathers of Texas, while serving in the State Constitutional Convention of 1876 and the legislature of 1883, donated to the University of Texas two million acres of semi-arid land, situated in the remote and sparsely settled western part of the state, they builded much better than they knew. In a financial sense, the gift at the time it was made was of little worth, the land having a sale value of only a few cents per acre.

Upon a block of this land in Reagan County oil was discovered on May 27, 1923. It marked the opening of the Big Lake oil field, which now contains a group of the deepest producing oil wells in the world, ranging in depth from 8525 to more than 9000 ft., and overlaid with a shallower producing sand only about 2000 ft. below the surface. Following the Big Lake wildcat discovery, five other fields in as many counties, all on University lands, have been developed and are contributing a share of the wealth that is coming to that institution of higher learning.

It was not until late in 1924 that the income of the University from oil attained any magnitude. The payments to the institution from lease bonuses, rentals, royalties and other allied sources have mounted to a total of more than $22,000,000 since that time.

All the institution's oil money goes into its permanent fund. The income from this fund, which is invested in high class securities, is divided, two-thirds going to the University and one-third to the State Agricultural and Mechanical College. This money, together with that which comes wholly to the University from its grazing leases, has been applied to the construction of a magnificent group of 18 new buildings upon the campus of the institution at Austin since 1925.



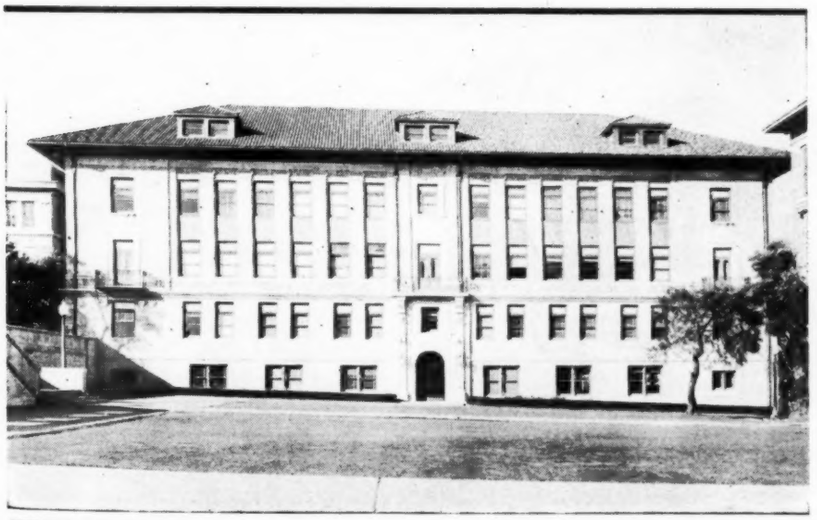
Engineering Building and Power Plant, University of Texas

In full keeping with the prominent part that the oil and gas industry of Texas has had to do with the expansion of the physical plant of the University of Texas, that institution has in its curriculum, courses in petroleum engineering.

Although the first course in petroleum engineering at the University was not established until 1928, with about ten students, the enrollment has increased to 123 students enrolled in the 1935-1936 long session. Of this latter number, eight are candidates for the Bachelor of Science degree and one for the Master of Science degree. In addition to 123 students who enrolled for petroleum engineering for the current long session, there are 197 taking preliminary courses preparatory to majoring in petroleum engineering. These required courses include civil engineering, mechanical engineering, chemistry, physics, geology, and mathematics. The teaching staff of the department, of which F. B. Plummer is chairman, has grown from one full-time member in 1928 to three full-time members in 1935-36.

The laboratory equipment of the petroleum engineering department is of the most modern type. In its larger laboratory the facilities enable students to make every oil field test that petroleum engineers are called upon to make in the field. These include, among others, core valuations, porosity and permeability of sands, water drive, bottom-hole pressure, gas repressuring, water-flooding, and crude gravity tests. In the laboratory, sands from North Central Texas, East Texas, and Southwest Texas are under test, the results of which will be made available to the

Geology Building, University of Texas



industry in printed form. A new laboratory has been established in the department this year where research is being carried on in gas flow and measurement.

Students are given a practical insight into drilling operations by drilling a well on the University campus. This well is some 300 ft. deep and is equipped with casing; later, tubing will be placed and pump installed.

TEXAS A. & M. COLLEGE

By J. M. SHEPHERD

TEXAS Agricultural and Mechanical College occupies a very definite position in the matter of training young engineers for Texas' leading industry—petroleum. Sixty-eight college undergraduates enrolled in the school of petroleum engineering when it was first added to the curriculum but seven years ago; today there are 375 embryonic engineers enrolled in that department. Each year has seen a steady increase in the enrollment of the department, the greatest advance being recorded between the sessions 1933-34 and 1934-35. Students to the number of 142 were in regular attendance in June, 1934. In September of the same year 285, a 100 percent increase, were on the rolls.

Phenomenal though this growth has been, it has been a natural one. Broadening of the curriculum and improvement in facilities have warranted that growth.

In the year that saw the enrollment doubled, Harold Vance, widely-known petroleum engineer, became head of the petroleum department. Since assuming the direction of the department, Professor Vance, with the aid of Associate-Professor A. B. Stevens, has expanded laboratory facilities and broadened the curriculum.

In response to the ever-growing conviction that college engineering courses should be extended over a five-year period, two courses are offered today to prepare students for the drilling, production, and transportation branches of the oil and gas industry. One, a regular four-year course in petroleum engineering, leads to the degree of Bachelor of Science, and the other, a five-year course, to the degree of Bachelor of Petroleum Engineering.

Throughout both courses, training is given in civil, mechanical, chemical, and electrical engineering; general, historical, structural and petroleum geology; and minerology and petrology. Students thus are prepared to apply the principles of these various subjects to the larger field of petroleum engineering.

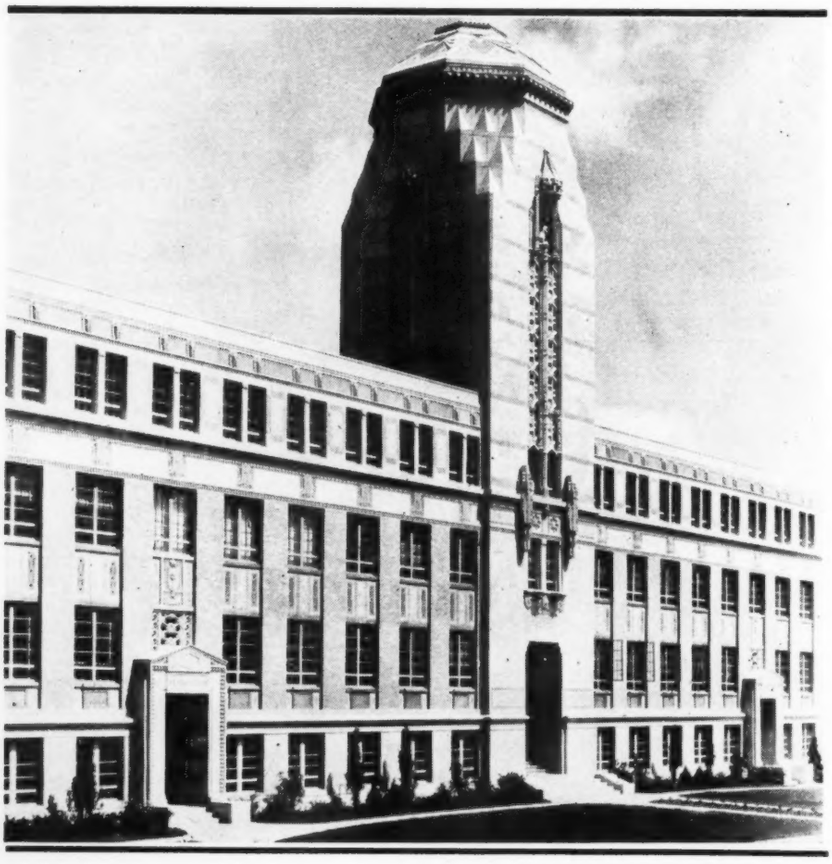
Laboratory equipment on hand is valued at $50,000. A new portable rotary drilling rig recently has been added, capable of drilling to a depth of 1000 ft., and testing to a depth of 500 ft. additional. This rig, with the winch and water truck owned by the department, enables students actually to spud in, drill, set casing, cement, and core as part of their laboratory work.

Portable rotary drilling equipment, Petroleum Engineering Department, Texas A. & M. College

Within the laboratory are two wells belonging to the mythical A. and M. Oil Company. One is pumped by an electrically-powered unit and the other uses gas-lift to bring oil to the surface. Gas flow measuring apparatus, permeability and porosity machines, viscosimeters, flash and fire point devices, and other pertinent paraphernalia, all necessary to supplement theoretical study, are regularly used in laboratory work.

Experience has shown the advisability of close contact with current advances in the industry and, through biweekly meetings of the A. and M. Chapter of the American Institute of Mining and Metallurgical Engineers, association with many leaders in the industry is made possible. During the past year not only engineers connected with the major oil companies of Texas, but such outstanding men as Professor L. C. Uren, of the University of California, and Col. E. O. Thompson, chairman of the Texas Railroad Commission, have attended these meetings as guest speakers and have discussed both technically and generally various problems of the type with which the student will be confronted when he takes his place in the field.

Petroleum-Geology Building, A. & M. College



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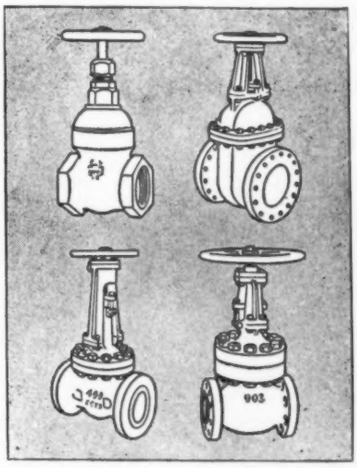

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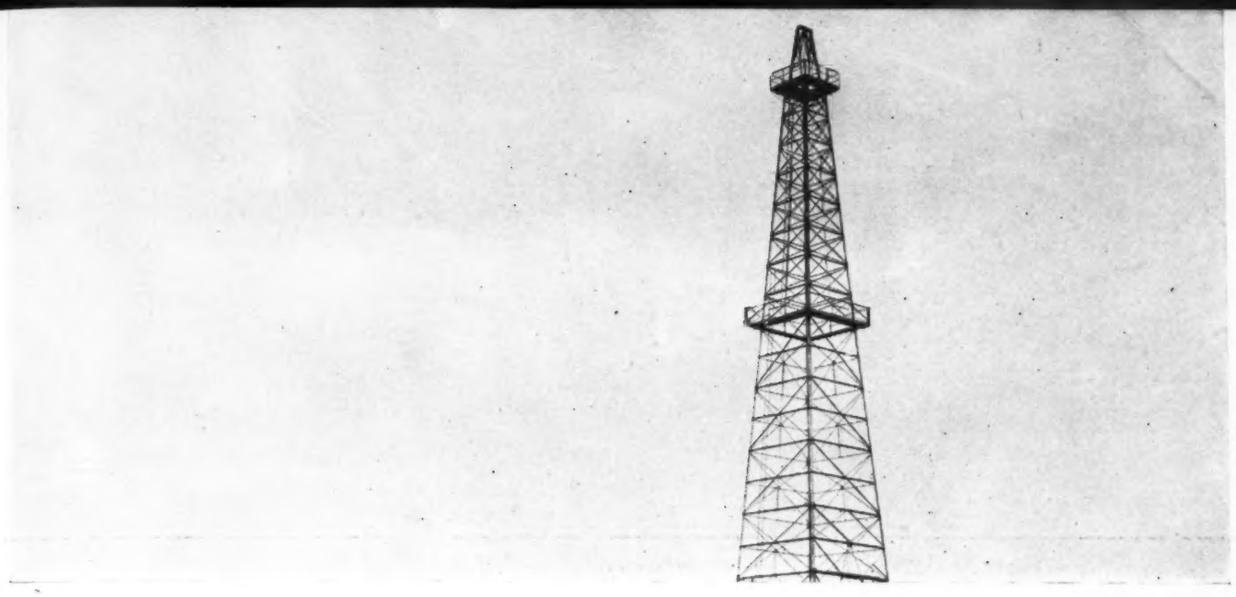


Review of Petroleum Development in Coastal Texas

Drilling operation on Gulf Coast of Texas

INTRODUCTION

IN quest of riches, Coronado, famed explorer, missed a greater wealth some five centuries ago, in his long search throughout the Southwest—for the route of his travels encompassed the richest of the nation's 22 oil states. For Texas today produces 44 percent of the nation's crude oil output (although restricted by proration) to rank at the top. One oilfield alone in this storehouse of petroleum treasures—East Texas—for a time supplied one-fourth of the world's oil requirements. It is indeed difficult to comprehend the vastness of the oil resources of the Lone Star State, what with production already obtained from 137 counties, as its occurrence runs the entire range of geologic sediments—from the Ordovician to the Pliocene, with the exception of the Cambrian, the Jurassic, and the Triassic. From depths as shallow as 500 ft., as in Nacogdoches County near the Louisiana border, to depths as great as 9370 ft. in the Oligocene sediments in Matagorda County on the Gulf Coast, is accumulated the black gold of this huge state. The limits of deep production have many thousands of feet yet to be reached in the Gulf Coast region, and in the Woodbine interior basin producing depths of 8800 ft. may be yet exceeded as the quest of much-needed reserves sends the wildcatter's drill in search of deeper-seated salt domes. In little less than four decades, oil has vaulted the economic growth of Texas from that of a principal agricultural and cattle country to the premier oil producing state, and also second to none in oil refining.

FOREWORD by the AUTHOR

What was once a cattleman's empire has become the nation's largest and most important oil-producing state. Six years ago oil displaced cotton as king in Texas. Time and again the most spectacular oil booms of the industry are enacted in one of the 100-odd counties where oil has been developed.

A review of the development of petroleum in Texas is presented in this series of articles, which for convenience cover the various districts recognized by the oil industry.

JOSEPH A. KORNFELD,
Houston, Texas.

A conception of the phenomenal development of the oil industry in the Lone Star State may be gained from the fact that from the discovery of oil in 1866 at Nacogdoches to January 1, 1935, 3,793,000,000 bbl. of oil were produced. This crude had a valuation of $4,362,000,000 and of this amount $400,000,000 was used in construction of refineries; $450,000,000 was devoted to construction of oil pipe lines; $545,000,000 was received by fee owners and other royalty owners; while more than half of the total amount was used in drilling wildcat wells and developing producing properties. In addition, Texas has the largest petroleum reserve in the nation, 5,500,000,000 bbl. having been conservatively estimated from reliable statistical reports. This proven volume is more than 2,000,000,000 bbl. greater than that of California, which holds second place, or greater than that of California and Oklahoma (1,200,000,-

Night view of a refinery on Gulf Coast of Texas

000 bbl.) combined. Today the wildcatter's drill is active in no less than 103 of the 254 counties that comprise the state of Texas.

Huge uplifts, such as the Sabine and the Llano-Burnet domes, 63-mile long shorelines such as in East Texas, fault zones hundreds of miles in lengths, long barrier reefs, and hundreds of salt domes, from 100 to 12,000 ft. in depth from the surface, form the chief modes of occurrence and types of accumulation whose intricacies will assure greater reserves than was once thought possible even by the most informed of the geologists of the state. Gigantic basins, extending 20,000 ft. in depth in the Gulf Coast region, to 12,000 ft. in the Woodbine basin, to 11,000 ft. in the Permian basin of West Texas, and to 15,000 ft. in the Rio Grande embayment, provide potential source beds for untold billions of barrels of crude, and are not ordinarily realized in reserve estimates. So huge is Texas in oil resources from a geographic angle, that a distance of more than 700 miles represents the greatest span between two fields inside the state's boundaries—from Hutchinson County in the Texas Panhandle to Hidalgo County in the Rio Grande Valley.

Representing almost one-fifth of the total oil investment in the United States, Texas oil trade is estimated at three billions of dollars per year. The Gulf Coast refineries alone carry a pay roll of approximately $100,000 per day, giving employment to 25,000 men. The oil pipe line system of Texas transports 300,000,000 bbl. of crude oil to market each year, with an aggregate value of $460,000,000 (based on the 10-year average price for oil). The destination of the bulk of the oil handled through these gigantic arteries of commerce are the gulf ports at Houston, Port Arthur, Orange, Ingleside, Aransas Pass, and Beaumont, where it is refined or shipped in tankers, whose principal ultimate destinations are the great metropolitan gasoline markets in Philadelphia, Boston, and New York. Texas has 230 refineries with a daily crude capacity of 1,238,000 bbl., larger than that of California and Oklahoma combined.

During 1935, 8,448 producing wells were completed in the state, according to an official report of the Railroad Commission. Of these 7,956 were oil wells, while the remaining 492 were gas wells. In that year, 1074 new permits were granted for well locations. More than 520 separate and distinct oil fields have been discovered and developed since 1866, the beginning of the Petroleum Industry in Texas.

Texas has an estimated aggregate of 153,000,000 acres of oil land, of which 45,000,000 acres are under lease. To date, acreage under production is in excess of 1,800,000 acres. More than 30 geological formations in the state are productive of petroleum and natural gas.

MILLION-DOLLAR OIL COUNTIES

Oil is today King in Texas and of its 115 productive oil counties, 46 produced more than 1,000,000 bbl. each during the fiscal year, as shown in the annual report of Comptroller George Sheppard of the State of Texas. The comptroller's report of production is based upon the number of barrels of oil upon which the state's gross production tax was paid. During the fiscal year a total of 362,150,011 bbl. was produced. The average price of oil during that period was $1 a barrel.

Counties in the million-dollar class, and their production in bbl. for the year, are:

Anderson	1,496,799
Archer	6,722,985
Austin	1,591,078
Bee	1,687,891
Brazoria	3,249,187
Caldwell	3,603,175
Carson	1,942,207
Chambers	7,221,430
Crane	3,269,483
Duval	7,919,772
Eastland	103,372
Ector	3,074,657
Fisher	2,012,986
Fort Bend	7,646,945
Galveston	2,628,499
Glasscock	1,911,466
Gray	11,563,159
Gregg	81,992,474
Guadalupe	3,224,510
Hardin	1,574,769
Harris	5,586,742
Howard	4,969,425
Hutchinson	4,216,757
Jefferson	1,304,495
Liberty	4,111,011
Montague	1,952,604
Montgomery	15,810,377
Navarro	1,073,640
Nueces	1,027,399
Pecos	16,178,360
Reagan	4,137,000
Refugio	6,527,999
Rusk	57,569,880
Shackelford	2,081,156
Smith	6,558,829
Stephens	1,937,741
Upshur	8,571,387
Upton	3,084,840
Van Zandt	14,274,438
Ward	5,434,846
Webb	1,725,382
Wheeler	3,038,284
Wichita	4,974,987
Wilbarger	3,088,461
Winkler	7,397,795
Young	3,350,690

Counties listed as producing less than 1,000,000 bbl. during the year are:

Andrews, Atascosa, Bastrop, Baylor, Bexar, Brown, Calhoun, Callahan, Cherokee, Clay, Coleman, Comanche, Cooke, Crockett, Deaf Smith, Erath, Falls, Foard, Frio, Garza, Goliad, Grayson, Harrison, Haskell, Hidalgo, Houston, Hudspeth, Irion, Jack, Jackson, Jasper, Jim Hogg, Jim Wells, Jones, Karnes, Kleberg, Limestone, Live Oak, Loving, Marion, Matagorda, McCulloch, McLennan, McMullen, Medina, Menard, Milam, Mitchell, Moore, Motley, Orange, Palo Pinto, Panola, Polk, Runnels, San Patricio, Scurry, Starr, Taylor, Throckmorton, Travis, Victoria, Waller, Washington, Wharton, Williamson, and Zapata.

ANNUAL PRODUCTION SUMMARY STATE OF TEXAS

Year	Output Thousands of Bbl.	Value Thousands of Dollars
1896	1	.....
1900	836	.....
1901	4,394	1,247
1902	18,084	3,998
1903	17,956	7,517
1904	22,245	8,156
1905	28,136	7,552
1906	12,568	6,566
1907	12,323	10,402
1908	11,207	6,700
1909	9,534	6,793
1910	8,899	6,605
1911	9,526	6,554
1912	11,735	8,852
1913	15,010	14,675
1914	20,068	14,942
1915	24,943	13,026
1916	27,645	25,760
1917	32,413	42,891
1918	38,750	74,867
1919	79,366	157,729
1920	98,868	313,781
1921	106,166	162,663
1922	118,684	189,175
1923	131,023	193,580
1924	134,522	203,870
1925	144,648	262,270
1926	166,916	308,700
1927	217,389	248,550
1928	257,320	236,300
1929	296,876	322,520
1930	292,392	.....
1931	328,608	.....
1932	314,378	.....
1933	401,808	.....
1934	378,233	.....
1935	391,592	.....

Proven Reserves. As previously mentioned, the proven oil reserves of Texas, estimated at 5,500,000,000 bbl., are equivalent to those of California, Oklahoma, and Kansas together, next ranking states in volume of reserves; Texas' reserves also are greater than those of all the remaining oil-producing states excluding California. The following tabulation, prepared by the American Petroleum Institute through its Special Committee on Production and Supply, lists the oil-producing states and their proven reserves in order of importance. (See also, accompanying map of the United States)

State	Reserves (Bbl.)
Texas	5,500,000,000
California	3,500,000,000
Oklahoma	1,200,000,000
Kansas	400,000,000
New Mexico	350,000,000
Coastal Louisiana	350,000,000
Wyoming	250,000,000
Pennsylvania	240,000,000
Arkansas	75,000,000
Montana	60,000,000
Northern Louisiana	55,000,000
Michigan	45,000,000
New York	40,000,000
Kentucky	35,000,000
Illinois	35,000,000
Ohio	30,000,000
West Virginia	25,000,000
Colorado	12,000,000
Indiana	5,000,000

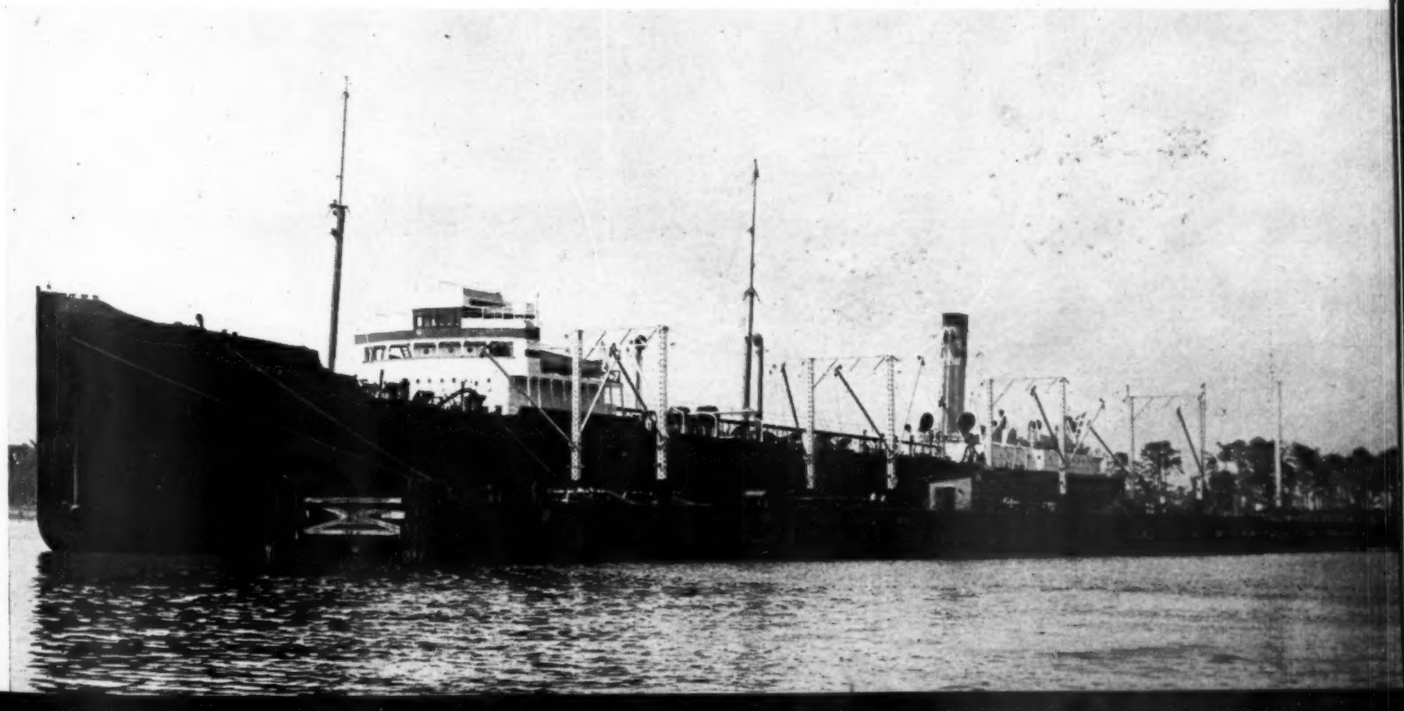
EARLY DISCOVERIES

The history of the spectacular oil development that characterizes Texas goes back to a quiet, almost non-commercial project near Nacogdoches, scene of the state's first mission near the Louisiana border. Ten miles southeast of that county seat oil was struck in 1866 at a locality subsequently and appropriately known as Oil Spring. A pipe line 15 miles in length was laid to Oil Spring from the city of Nacogdoches, but the production soon became depleted and the pipe line was taken up because further production from the 200-ft. sand proved nonfeasible. In 1894, the area was reworked and deeper production found at 600 ft., which proved more productive and led to the drilling of more than 90 wells, activity being due principally to the fine lubricating quality of the crude. So valuable is this particular supply that a commercial oil mine is maintained on the field, the only one of two in the nation today on a commercial scale.

What was to become the scene of the first real commercial production in the state was the discovery at Corsicana in 1895 after a strong oil showing found the previous year in an artesian well on the townsite drew the excitement of the local citizenry. Three wells drilled for water were burned down due to ignition of the seepage of oil from a depth of 1035 ft., before a water well was successfully completed. The first oil producer in Corsicana was completed October 15, 1895, at a location 200 ft. south of the city's artesian well. Two Corsicana citizens, H. G. Damon and Ralph Beaton, made possible the financing of the well, which was drilled by John Davidson, an old-time oil well driller from the East. The pioneer well there came in for only two and one-half bbl. per day. By the end of the following year, more than six oil producers were completed, building up production to 1450 bbl. (cumulative total). Production reached a total of 65,000 bbl. by New Year's Day of 1898, and before the turn of the century more than 3,000,000 bbl. had been produced.

In three other localities, however, small oil production was being developed at the time; before Spindletop was discovered. In southern Bexar County, south of the city of San Antonio, oil was found in 1896 at a depth of 600 ft., but the tests proved

An installation such as shown here is capable of loading tankers at the rate of 10,000 bbl. of crude per hour. This view is the Baytown loading terminal of the Humble Oil and Refining Company on the Houston Ship Channel



small pumpers. In 1900, oil was found in Caldwell County near the town of Lockhart. About the same time small oil production was uncovered southeast of Palestine in Anderson County in the East Texas "outside" region.

THE GULF COAST

The first major oil boom in the Lone Star State followed the spectacular discovery of oil at Spindletop—which opened up the Texas Gulf Coast at a small mound outside of Beaumont in Jefferson County. In 1892, the first company organized to prospect at Spindletop was headed by one Patillo Higgins, a Beaumont resident who organized the Gladys City Oil, Gas, and Manufacturing Company. In 1893, the first well to be put down on the mound was started with M. B. Looney of Dallas as drilling contractor. It was abandoned in quicksand at 418 feet. Nothing more was done for two years, but in 1895 a second test was drilled and the following year a third dry hole was chalked up as a failure. Higgins withdrew from the Gladys company and in 1899, after inserting an advertisement in a publication, attracted Captain Anthony F. Lucas to maining departments of the company the prospect. Lucas, a graduate engineer of the Polytechnic Institute at Graz in Europe had served as a midshipman in the Austrian Navy. When he first came to the United States, he worked as a mining engineer in a Louisiana shallow salt mine. While working in Louisiana, he noted the presence of hydrogen gas and oil on the flanks of known shallow salt domes. When the Spindletop prospect was advertised, he got in touch with the Gladys company and came to Beaumont, signing a contract for the drilling of a test well.

The test that proved to be the discovery was spudded in October 20, 1900. Curt Hamill of Houston was engaged as driller. A crude rotary rig was used, marking the beginning of the rotary method of drilling in the coastal fields. Nothing was noted until January 10 of the following year when oil showed in the ditch. While the crew was changing bits that morning the pumps were shut down and the release of pressure resulting allowed the well to clean itself—with a flow conservatively estimated at 60,000 bbl. per day, as the gusher spouted 200 ft. into the air.

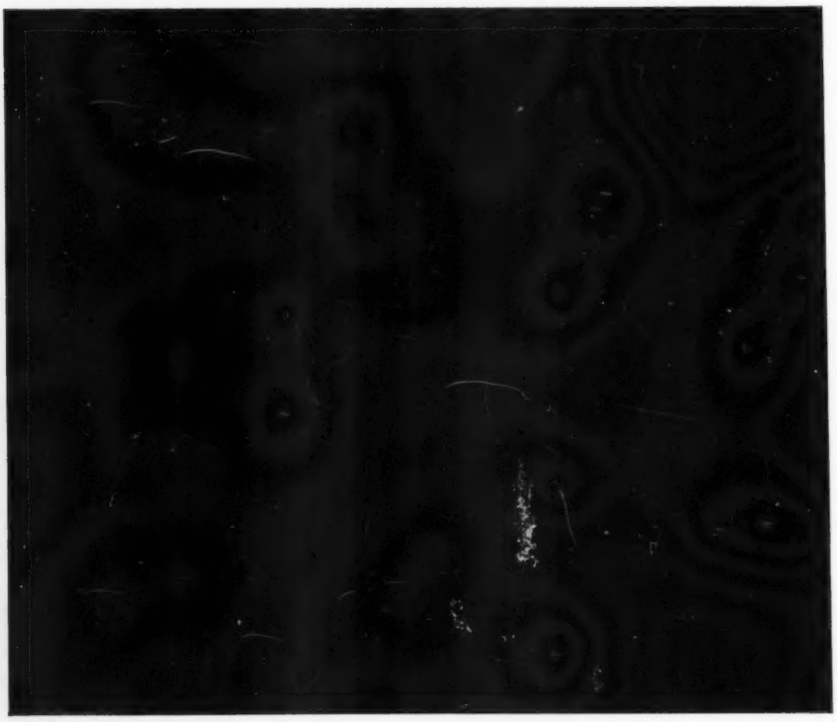
The Spindletop boom that ensued was unparalleled in the history of the oil industry. Like the locusts of Egypt, operators were drawn from all parts of the nation into the vortex of a wild orgy of drilling and speculation. More than 500 derricks were erected on 140 acres of land. From a rice town, Beaumont, the center of the boom, became somewhat like a mining camp. A tract 25 ft. square (1/64th of an acre) sold for $5,000 as leases were subdivided into drilling sites.

Spindletop vaulted Texas oil production from 2,119,000 bbl. in 1900 to 4,394,000 bbl. in 1901. By 1902, it reached a peak of 17,421,000 bbl. under a tide of overproduction, comprising at the time 96 percent of the state's production. The following year the output dropped off until the production for the year was only 17,956,000 barrels. Oil had dropped to ten cents a barrel during the peak year.

The famous Gulf Oil Corporation had its inception at Spindletop. J. M. Guffey, who was enlisted by Captain Lucas in the drilling of the discovery well at Spindletop, had been a prominent Pennsylvania operator. Guffey had organized the J. M. Guffey Petroleum Company in order to handle his properties in the new field near Beaumont. In order to finance a huge drilling program, Guffey turned to his Pittsburgh friends, particularly to the Mellons who underwrote a bond issue. The Mellons, who had been connected previously in the oil industry through ownership of oil pipe lines, came into possession of the Guffey organization when the latter found himself in financial difficulties. Later the Gulf Production Company was organized, the Gulf Pipe Line Company, and other subsidiary companies whose scope of operations extended into Louisiana, Oklahoma (Gypsy Oil Company), California, Venezuela, Mexico, etc.

Another major company was to result from a subsequent development to the north in the Sour Lake field of Hardin County. J. S. Cullinan, another Pennsylvanian, had started the state's first refinery at Corsicana, operated under the name of the J. S. Cullinan Company, the forerunner of the Magnolia Petroleum Company. Later he organized the Texas Fuel Company to operate at Spindletop. After the scramble for acreage waned at Spindletop, Cullinan turned his efforts to nearby dome prospects and uncovered a locality at Sour Lake, a health resort in the adjacent county to the north. He arranged to drill three test wells there, agreeing to pay $1,000,000 for an option on the land in the event oil was discovered. To take over all the obligations and properties of the Texas Fuel Company, The Texas Company was organized that year; but the million dollars necessary for the development of the Sour Lake prospect was not available by anyone connected with the newly-organized company.

In search of outside capital for the necessary development, Cullinan learned of a capitalist at Port Arthur who was well known in financial circles, although not engaged in the oil industry. John W. Gates, the financier in question, was mainly interested in developing Port Arthur. After finding



Map showing proven oil reserves of the United States

Gates at a Florida resort, Cullinan sold him on the value of oil industrial activity to Port Arthur and as a result obtained the necessary loan. The first test put down by The Texas Company found only pumper production; but the third test proved a gusher. Its success was assured the following year when 119 substantial stockholders were added to the company.

Cullinan originally had come to Texas from Pennsylvania in 1897. He came at the insistence of the mayor of Corsicana and his associates to look over the situation in that area, where the first large commercial production of oil had been found in Texas, with the view of building a refinery. With the backing of Calvin N. Payne and Henry C. Folger this was done, and, as mentioned, this was the real beginning of the Magnolia Petroleum Company. It was not known by that name until later, however. After Cullinan sold the refinery it was operated under the name of the Navarro Refining Company. In 1901 George E. Burt and Company built a refinery at Beaumont near the Spindletop field as huge volumes of the rich oil were available from the near-by gushers at periodic intervals of low prices and overproduction. The late John Sealy had purchased at a receiver's sale in Austin on December 7, 1909, the assets of the Navarro Refining Company of Corsicana and the Security Oil Company of Beaumont, both of which he reorganized into the John Sealy Company. This property comprised the Corsicana and Beaumont refineries and 250 tank cars besides sundry equipment. On April 24, 1911, the owners of the John Sealy Company organized the Magnolia Petroleum Company, as a joint stock association with Mr. Sealy as president. The organization was incorporated under the laws of Texas on December 15, 1925, when the pipe line department was separated from the reknown as the Magnolia Petroleum Company. In recent years, the Magnolia has become a subsidiary of the Standard Oil Company of New York and the Socony-Vacuum Corporation.

Since the first gusher was brought in during 1901 at Spindletop more than 18,400 tests for oil have been drilled in the Texas Gulf Coast. Of these 11,200 proved to be oil producers, and 7200 were failures.

Other fields were found in the same area at Batson in 1903, at Saratoga in 1904. East of Humble, in 1905, was uncovered what proved to be the third largest field in the Gulf Coast of Texas, and whose present cumulative production is 115,000,000 bbl., ranking next to Spindletop and Conroe. Humble increased the output of the state to 28,136,000 bbl. by 1907.

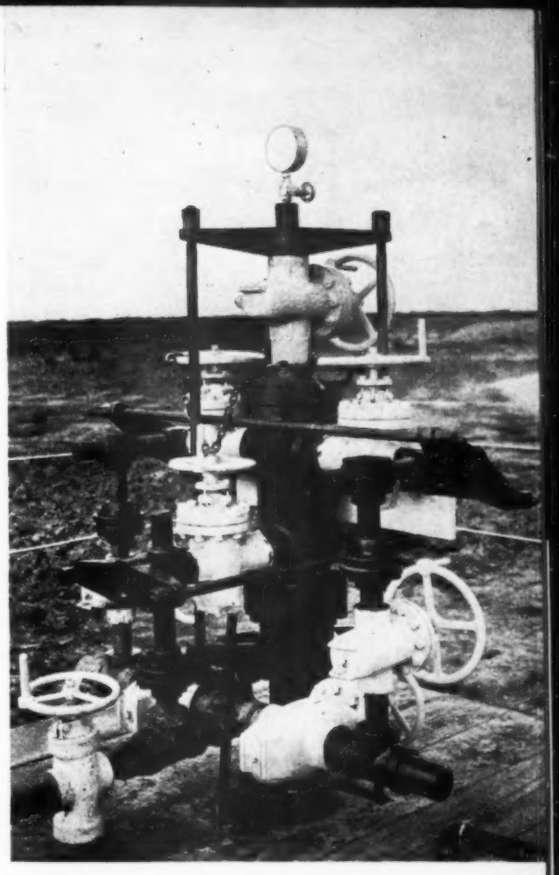
Spectacular Producers. Huge gushers were found at exceedingly shallow depths from the cap-rock overlying the crest of the numerous shallow piercement-type salt domes that furnished the bulk of the Gulf Coast production up to the time of the World War. The shallowest of these wells was the Granbury and Staiti No. 1 D. R. Beaty in the Humble field of Harris County, both of which opened up a 115,000,000 bbl. field. It came into production in January of 1905 northeast of the town of Humble for an initial production estimated at 5000 bbl. per day from a depth of 700 feet.

In the fall of the same year, in western Liberty County nearby, Paraffin Oil Company brought in their No. 3 Fee on the North Dayton dome for an initial production of 5000 bbl. per day from a depth of 800 feet.

The Gulf Coast development from Spindletop to the beginning of the World War totaled 190,000,000 bbl. from strata of Miocene and Pliocene age, obtained from the cap rock of the shallow salt domes of the Gulf Coast belt. Production, mainly from the Miocene, was in excess of 310,000,000 bbl. to 1930. Output from the Oligocene formations was brought into prominence in 1931 with the discovery of the Thompsons oil field of Fort Bend County, a reserve estimated at 260,000,000 barrels. Production from the Yegua formation was discovered in 1931 at Conroe in Montgomery County. Already more than 14 fields have been uncovered in that pay zone along the course of the Jackson trend in the Gulf Coast region.

Lower Claiborne production was was first found in the Gulf Coast region in 1926 when the Sun Oil Company developed Clay Creek in Washington County. Through 1935, more than 3,250,000 bbl. had been produced, indicating the potentialities that may be expected from these lower pays. Similar production, amounting to a reserve of two and one-half million bbl., developed from lower Claiborne formations in September, 1932, at Kittrell in southern Houston County.

Deeper and deeper reserves have been vaulting steadily the known reserves of the Gulf Coast. Lower Oligocene or Vicksburg production was uncovered in the Esperson field in 1935, likewise at Pierce Junction. Below the Yegua, production has been built up steadily in the Upper Saline Bayou phase of the Claiborne group.



Streamline Christmas tree on Steinberger Petroleum Corporation's discovery well in Port Lavaca field

Occurrence of Production, Texas Gulf Coast District

Pliocene Production:
Barbers Hill, Orange, Damon, Goose Creek, Saratoga, Port Neches, Moss Bluff.

Miocene Production:
Allen, Barbers Hill, Manvel ,Danbury, West Columbia, Nash, Mykawa, Hankamer, Blue Ridge, Humble, Markham, Pierce Junction, Port Neches, Orange, Sour Lake, Rabbs Ridge, Saratoga, Spindletop, High Island, Hull, Goose Creek, Fannette, Esperson, North Dayton, Damon Mound, Brenham.

Oligocene Production:
Barbers Hill, Batson, Big Creek, Ariola, Blue Ridge, Buckeye ,Orange, West Columbia, Damon Mound, Dayton, Louise, Esperson, Fannette, Hull, Garwood, Goose Creek, South Liberty, Humble, Van Vleck, Lost Lake, Moss Bluff, Manvel, Pierce Junction, Orchard, Nash, Mykawa, Pledger, Saratoga, Spindletop, Rabbs Ridge, Sour Lake, Sugarland.

Jackson Production:
Esperson, Humble, Hull, Manvel, Raccoon Bend, South Liberty, Rockland, Sour Lake, Livingston.

Cockfield Production:
Conroe, Cleveland, Splendora, Livingston, Humble, Raccoon Bend, Tomball, Schwab-Kirby, Garwood, Eureka.

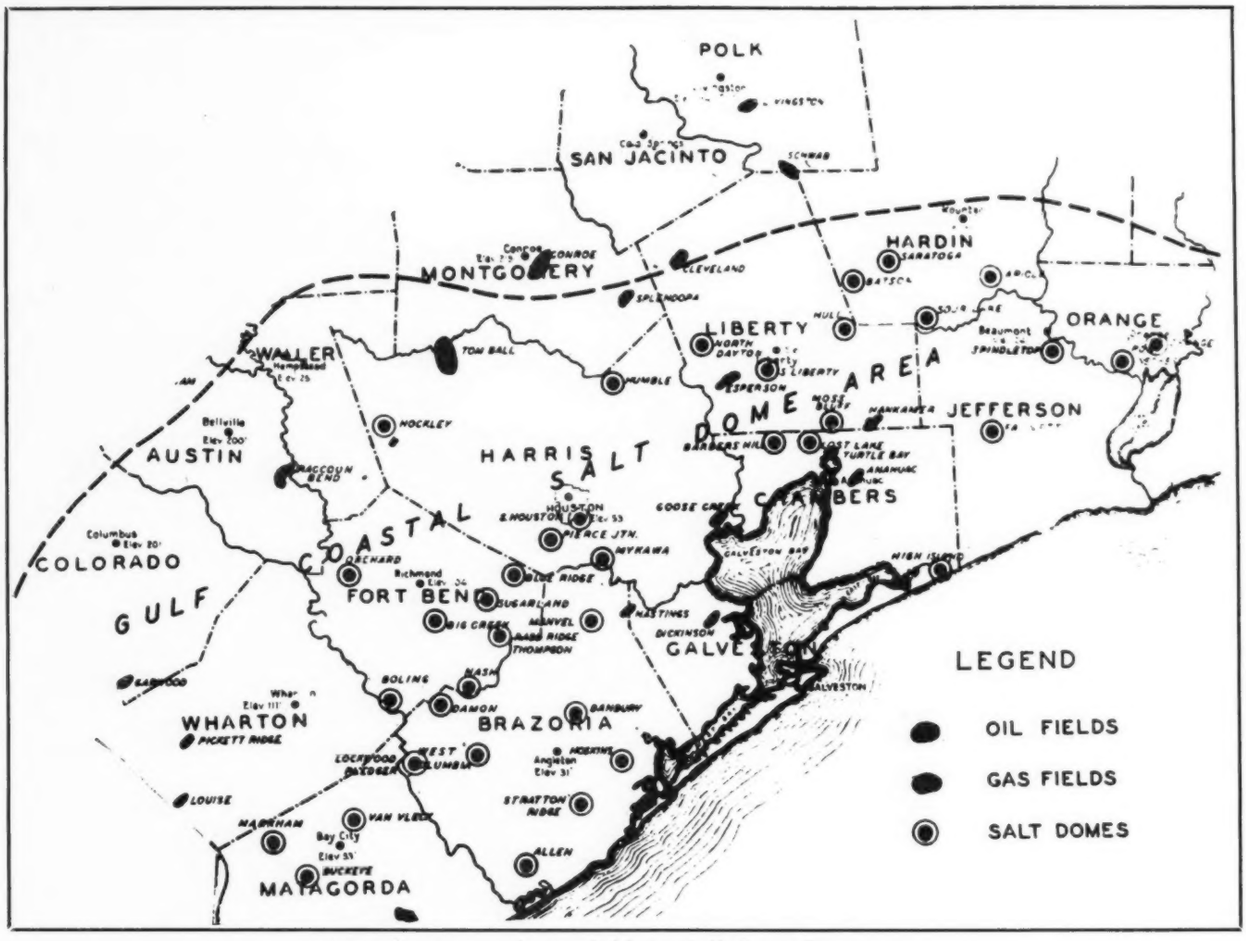
Yegua Production:
Rockland, Sour Lake, Hull, Orchard, Hardin, Humble.

Cook Mountain Production:
Esperson, Clay Creek, Humble, Hull.

Mount Selman Production:
Clay Creek, Kittrell.

Wilcox Production:
Clay Creek, Kittrell.

Conroe. What proved to be the bon-



Map showing producing fields in Gulf Coast Texas area

anza of the Gulf Coast region was the Conroe pool, discovered east of the Montgomery County seat on December 13, 1931, a real Christmas present to the coastal region. The discovery well was George W. Strake's No. 1 South Texas Development Company, which came into production from a depth of 4991 ft. for an initial production of 100 bbl. of distillate of 54 gravity and 15,000,000 cu. ft. of gas per day. Major companies did not enter the development in a big way until June 5, 1932, when Strake's No. 2 South Texas Development Company was completed in the Conroe sand at 5026 ft. for an initial output of 1200 bbl. of 38-gravity crude oil per day through a ½-in. choke.

By 1933, a bona-fide drilling boom followed that saw 90 drilling rigs active in the first month of that year, and resulted in more than 823 oil wells being completed by 1936. By the end of 1934, the Conroe field had produced 41,376,229 bbl. of crude oil. It is reliably estimated that the ultimate recovery from this field will be 512,000,000 bbl. from its 17,250 productive acres. The recovery per acre is estimated at 26,750 bbl., ranging much higher for the productive Conroe sand, which has an average recovery of 34,200 bbl. from an average thickness of 56 feet.

The Conroe field is situated on the Jackson trend, being an oval-shaped faulted structure trending northeast to southwest. It proved the forerunner of wildcatting on a trend extending into Polk, Liberty, Austin, Waller, Grimes, Harris, Tyler, Newton, Jasper, Colorado, San Jacinto, and Hardin counties. Since that time, production has been found on the Jackson trend at Spurger in Tyler County, at Cleveland in southwestern Liberty County, at Livingston in southwestern Polk County, at Tomball in Harris County, at Raccoon Bend in eastern Austin County, and at Splendora in Montgomery County. Eventually the trend was followed into Louisiana where it proved productive in 1936 at Cheneyville in Rapides Parish.

By April of 1933, the development in the Conroe field surpassed the drilling activity of the East Texas oil field, thus becoming the nation's most active area. Conroe's 13,600 productive acres at the time in the upper and lower productive sands amounted to about one-seventh of that of the East Texas field.

Tomball. One of the monuments to geophysical exploration in the Gulf Coast was the discovery of the Tomball oil and gas field in northern Harris County, principally due to the torsion balance. The discovery well was brought in May 27, 1933, by Humble Oil and Refining Company and Magnolia Petroleum Company at their No. 1 J. F. W. Kobs from the Cockfield sand found at 5547-5569 feet. The initial production was 69 bbl. of 41-gravity crude per hour through a ½-in. choke. Some 9000 acres were outlined as being productive of oil and gas in the field. The Humble Oil and Refining Company began development of the Tomball townsite to the east of the field in 1935 when it obtained a lease of the townsite in return for supplying free natural gas and other concessions to the residents there.

Refugio. Northeast of Refugio one of the most important of the lower Gulf Coast fields was discovered May 19, 1933, by Greta Oil Company (Geo. B. Smith). Their No. 1 J. W.

O'Brien came into production from the Lower Oligocene formation from 4346 ft. to 4403 ft. for an initial production of 22 bbl. an hour of 21.6-gravity oil on a ¼-in. choke. The new strike, in northern Refugio County, received major company development, aided somewhat by its strategic position and proximity to tidewater and the refining center at Houston.

Tom O'Connor. In the same area another important field was opened in June, 1934, three miles southeast of the Greta field, by the Quintana Petroleum Company and the Humble Oil and Refining Company. Their No. 1 O'Connor in the J. M. Swisher survey came into production for an initial output of 1000 bbl. of 38.8-gravity oil per day from sand found from 5569 ft. to 5575 feet. A deeper pay sand was found at the northwest offset, No. 2 Tom O'Connor, which made an initial flow of 1038 bbl. of oil per day from 5796 ft. to 5808 ft. under a tubing pressure of 1175 lb. and a pressure of 1700 lb. on the casing. In all, 26 wells were completed without a single dry hole intervening, as two rigs were kept in continuous operation for the following two years.

Frio Sand Production. The most prolific pay sand of the Gulf Coast region is the Frio sand series of the middle Oligocene, productive in 37 fields situated in 19 coastal counties. An up-to-date summary shows the following tabulation:

County	Field
Chambers	Anahuac
	Barbers Hill
Colorado	Garwood
Duval	East Cole
	Driscoll
	Piedras Pintas
Fort Bend	Blue Ridge
	Boling
Galveston	Dickinson
Hardin	Ariola
Harris	Mykawa
	Pierce Junction
	South Houston
Hidalgo	Sam Fordyce
	Mercedes
Jackson	Edna
	Mauritz
	Vanderbilt
Jefferson	Amelia
Jim Wells	Armagosa
Live Oak	Mount Lucas
Matagorda	Van Vleck
	Hamman
Nueces	Agua Dulce
	King
	Saxet
Refugio	Fox
	Refugio
	Tom O'Connor
Starr	Barbacoas
	Los Olmos
	Garciaville
San Patricio	Angelita
	Sinton
Victoria	Keeran
	McFaddin
Wharton	Louise

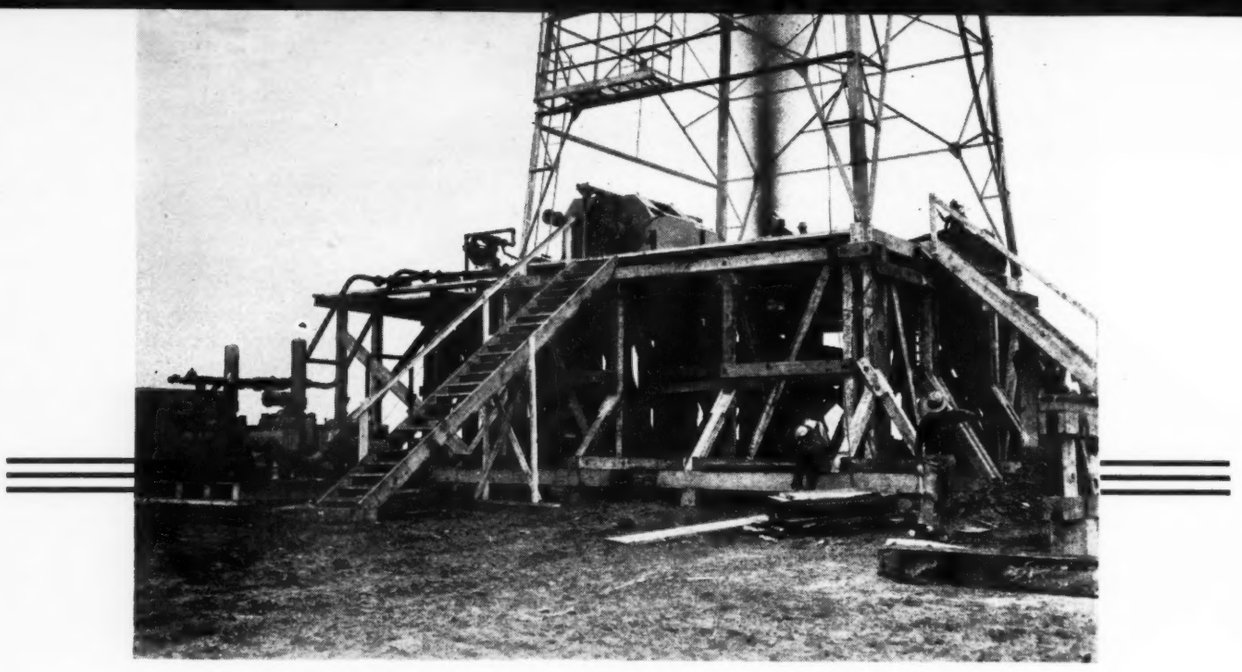
Hastings. A reserve with a present valuation of $200,000,000 was discovered on December 22, 1934, 14 miles south and slightly east of Houston by Stanolind Oil and Gas Company. The discovery well was on the Hastings prospect southeast of Pearland in northern Brazoria County at their No. 1 J. W. Surface in the A. C. H. & B. survey. It made an initial daily flow of 149 bbl. of 38-gravity oil from 5865 ft. to 5990 ft. under a tubing pressure of 2150 lb. and a pressure of 2400 lb. on the casing. It is situated five miles northeast of the Manvel field. The next year, Stanolind Pipe Line Company laid a feeder line to Webster, eastward, to tie in with the Pan-American Pipe Line Company trunk line extending southeast to the Texas City refinery of the Pan American Refining Corporation. By 1935, more than 22 oil wells had been completed in the new field. Deeper pay sands have been found but are being held in reserve.

Anahuac. What proved to be the largest producing deep-seated salt dome in the Texas Gulf Coast from an areal angle, was opened six miles east of Anahuac in western Chambers County on March 14, 1935. The discovery well was Humble Oil and Refining Company's No. 1 Archie D. Middleton situated on a block of 12,000 acres held entirely by the Humble company. The discovery well was completed flowing 20 bbl. of oil per hour under a tubing pressure of 1700 lb. from Frio sand found from 7028 ft. to 7088 feet. The prospect was made known in 1932 as the result of geophysical surveys using reflection seismograph and torsion-balance methods. Later in that year, Mason and McCarthy, Inc., extended the field 13,000 ft.—2¼ miles due north when their No. 1 R. M. White in the James McGahey survey was brought into production for 388 bbl. of oil per day through a ⅛-in. choke from the discovery sand. Subsequent drilling by the Sun Oil Company and the Humble in conjunction with Mason and McCarthy proved the intermediate territory to be almost all productive. This field has a large gas reserve; 500,000,000,000 cu. ft. is estimated to be the ultimate recovery.

Amelia. A similar situation is expected to follow in the case of the new West Beaumont or Amelia oil field in eastern Jefferson County near Beaumont, where Humble Oil and Refining Company's No. 1 Langham was brought in early in 1936 as the discovery well from the Frio sand. Another two-mile north extension was found in March of the same year by Glenn H. McCarthy at his No. 1 Longe, flowing two bbl. of 54-gravity distillate per hour from the discovery pay sand.

Prolific Producers. More than 15 million-barrel producers have been drilled in the Gulf Coast salt dome region to date. Of these, six were brought in by The Texas Company on the Carroll, Landslide, Stevenson, Kohler farms in the Humble field of northern Harris County, one of which produced 3,000,000 barrels. Several of these big wells were completed on the McFadden lease, in the Spindletop field of Jefferson County on the deep discovery lease of the Yount-Lee Oil Company. Their No. 63 McFadden produced more than 2,000,000 bbl. from a depth of 5000 feet. More than 16 million-barrel wells were completed in the West Columbia field by The Texas Company in the vicinity of the J. Hogg fee. The Texas Company's No. 58 Hogg, most prolific of all Gulf

Unitary type drawworks on a deep well at Bryan Mound, Brazoria County, Texas. This heavy-duty, three-shaft, four-speed drawworks has sufficient capacity to drill 10,000-ft. wells



In certain sections of the Gulf Coast area on deep drilling operations a substructure 20 ft. in height is required to protect against inundation resulting from river overflow, etc.

Coast producers made 4,690,000 bbl. up to January 1, 1933, from a depth of 2736 feet. In the Sour Lake field of Hardin County, Gulf Production Company and Humble Oil and Refining Company's No. 14 West produced 1,275,000 bbl. of oil before its abandonment in January, 1931. In the Pierce Junction field of Harris County, southwest of the city of Houston, Rio Bravo Oil Company recovered more than 1,000,000 bbl. from its No. 6 Fee. In the Goose Creek field of eastern Harris County near Baytown, Humble Oil and Refining Company completed its No. 10 State Land, and before depletion it produced 2,175,000 bbl. of oil. Gulf Production Company produced 1,680,000 bbl. of oil from its No. 1 Chapman-Bryan in the same field.

The most prolific production per acre in the Gulf Coast was uncovered at West Columbia in Brazoria County.

The three-acre Japhet fee produced 5,000,000 bbl., far in excess of one million bbl. to the acre, the richest spot in the Mid-Continent. The Texas Company's No. 1 Abrams, which blew into production on July 22, 1920, was one of the most spectacular producers in this outstanding field. It flowed from 34,000 to 36,000 bbl. per day for almost 40 days before its flow was controlled. It has been producing more than 16 years. Their No. 49 Hogg, which was completed the following year, produced 35,000 bbl. of oil per day for a 60-day period before the flow was killed; during the two-month period it produced 1,840,000 barrels. Crude oil was bringing $3.50 per bbl. at the time.

Pool Summary. The producing pools for the Texas Gulf Coast, their location, and their average daily crude oil production as of March 4, 1936, are summarized as follows:

Name of Field	County	Daily Production (Bbl.)
Ace	Polk	50
Allen	Brazoria	15
Amelia (West Beaumont)	Jefferson	100
Anahuac	Chambers	150
Ariola	Hardin	1400
Barbers Hill	Chambers	15,900
Batson	Hardin	2,000
Bay City	Matagorda	650
Big Creek	Fort Bend	1,000
Blue Ridge	Fort Bend	1,600
Boling	Fort Bend and Wharton	800
Brenham	Washington	20
Brookshire	Waller	20
Clay Creek	Washington	1,100
Cleveland	Liberty	850
Conroe	Montgomery	41,350
Damon Mound	Brazoria	500
Dickinson	Galveston	2,000
Esperson	Liberty	1,700
Fannette	Jefferson	1,100
Ganado	Jackson	100
Goose Creek	Harris	2,700
Hankamer	Liberty	2,150
Hardin	Liberty	300
Hastings	Brazoria	5,300
High Island	Galveston	6,700
Hull	Hardin	5,600
Humble	Harris	300
Kittrell	Houston	1,300
Livingston	Polk	2,600
Louise	Wharton	1,300
Lost Lake	Chambers	200

STRATIGRAPHY OF THE TEXAS GULF COAST
SEQUENCE OF TERTIARY FORMATIONS

Pleistocene:			Reynosa
Pliocene:			Lagarto
Miocene			Oakville
			Catahoula (Discorbis Bertheloti)
			Discorbis (Villardeboana)
Oligocene:	Upper:		Heterostegina
			Marginulina
	Middle:		Frio
	Lower:		Vicksburg (Textularia Warreni)
			Upper—Fayette (Whitsett)
Eocene:	Jackson		Middle—McElroy (Hockleyensis)
			Lower—Diboll (Caddell)
			Cockfield
		Yegua	Upper Saline Bayou
			Lower Saline Bayou
			Milans
		Cook Mtn.	Crockett
			Sparta
	Claiborne Group		
			Weches
		Mt. Selman	Queen City
			Reklaw
			Carrizo
		Wilcox	
		Midway	

Name of Field	County	Daily Production (Bbl.)
Manvel	Brazoria	7,800
Markham	Matagorda	1,300
Mykawa	Harris	3,500
Nash	Brazoria	50
North Dayton	Liberty	150
Old Ocean	Brazoria	400
Orange	Orange	700
Orchard	Fort Bend	700
Pickett Ridge	Wharton	850
Pierce Junction	Harris	3,700
Port Neches	Orange	1,800
Raccoon Bend	Austin	4,800
Rockland	Jasper	10
Saratoga	Hardin	850
Sour Lake	Hardin	1,550
South Houston	Harris	850
South Liberty	Liberty	700
Spindletop	Jefferson	2,200
Thompsons	Fort Bend	10,700
Sugarland	Fort Bend	5,600
Tomball	Harris	6,500
Turtle Bay	Chambers	200
West Columbia	Brazoria	2,450
Withers	Wharton	200
Agua Dulce	Nueces	100
Baldwin	Nueces	900
Caesar	Bee	1,400
Clara Driscoll	Nueces	100
Caletto Creek	Victoria	900
Dinero	Live Oak	100
Dirks	Bee	3,400
Fort Merrell	Live Oak	100
Greta	Refugio	15,800
Hords Creek	Goliad	50
Keeran	Victoria	300
Kingsville	Kleberg	50
Lucas	Live Oak	200
McFaddin	Victoria	25
McNeill	Live Oak	200
O'Connor	Victoria	300
Pettus	Bee & Goliad	4,100
Placedo	Victoria	1,800
Plymouth	San Patricio	7,200
Port Lavaca	Calhoun	700
Ray	Bee	1,300
Refugio	Refugio	4,400
Rutledge	Bee	100
Saxet	Nueces	6,100
Saxet Heights	Nueces	1,400
Sinton	San Patricio	50
Slick	Goliad and DeWitt	50
Taft	San Patricio	100
Tom O'Connor	Refugio	3,100
White Point	San Patricio	35
Whittington		50

SUMMARY OF GAS RESERVES IN HOUSTON AREA
(In part after C. D. Lockwood's Texas Oil Report, Houston)

Field	County	Productive Horizon	Ultimate Recovery
Dickinson	Galveston	Frio (Oligocene)	700,000,000,000
Pledger	Brazoria	Marginulina	1,000,000,000,000
Tomball	Harris	Cockfield	700,000,000,000
Conroe	Montgomery	Cockfield	470,000,000,000
Anahuac	Chambers	Frio (Oligocene)	500,000,000,000
Katy	Waller	Upper Claiborne	
West Mykawa	Harris	Lower Miocene	
Turtle Bayou	Chambers	Frio (Oligocene)	
Reserves within 50-mile radius of Houston			3,370,000,000,000

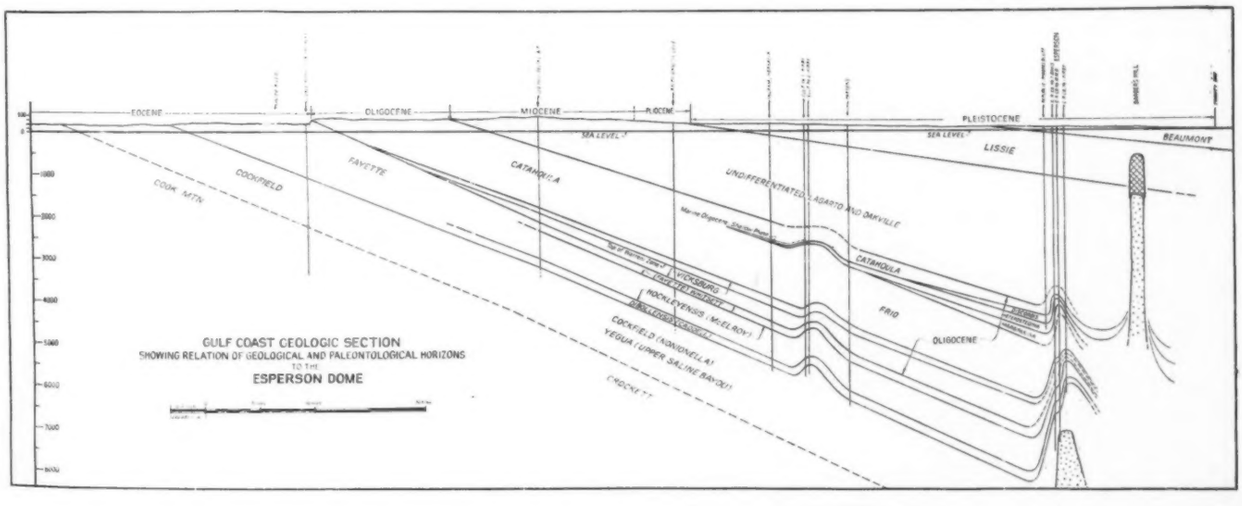
This summary of average daily output from the coastal fields represents a grand total of 220,000 bbl. on production. This comprises one-fourth of the entire daily output of the state of Texas, under proration restrictions.

Ranking Companies. A survey made at the beginning of the year shows the following ten ranking companies in the coastal Texas region (based on average daily allowable production and number of wells on production as of January 1, 1936):

In addition to the ten ranking companies here listed, important oil-producing companies active in the Gulf Coast region include Sinclair Prairie Oil and Gas Company, Shell Petroleum Corporation, Superior Oil Producing Company, Skelly Oil Company, West Production Company, Mills Bennett Production Company, Houston Oil Company, Navarro Oil Company, Magnolia Petroleum Company, and Kirby Petroleum Company.

Entrenchment of Standard of Indiana. Entrenchment of the Standard of Indiana into coastal Texas was effected on August 1, 1935, when its principal producing subsidiary, Stanolind Oil and Gas Company, purchased the assets of the Yount-Lee Oil Company for $43,000,000. Through the purchase, Stanolind obtained oil production in ten coastal fields, 265 oil wells in the East Texas field, a loading terminal on the Neches River with a loading capacity of 10,000 bbl. of oil per hour, a tank farm at Spindletop with a capacity of 6,000,000 bbl.; a 12-inch pipe line from High Island to Spindletop; and a third interest in a pipe line extending from Gregg County in the East Texas field to Beaumont. The purchase insured an adequate supply of crude oil for the Texas City refinery of the Pan-American Refining and Transport Company, a sister subsidiary of the Stanolind. The same year, Standard Oil Company of Indiana established the Pan-American Production Company to prospect, develop, and acquire production in the entire coastal region.

Consummation of the Yount-Lee deal added 20,000 bbl. daily production to the Indiana Standard's properties. The Texas production was strategically situated (with reference to tidewater refineries and loading terminals) in Chambers, Galveston, Liberty, Jefferson, and Hardin Counties, Texas, etc. The Yount-Lee Company was founded as a partnership in 1913 and by 1920 had developed to third



Rank	Company	No. Wells	Daily Allowable Production
(1)	Humble Oil and Refining Company	880	43,600 bbl.
(2)	The Texas Company	295	15,600 bbl.
(3)	Stanolind Oil and Gas Company	230	14,800 bbl.
(4)	Gulf Production Company	315	13,900 bbl.
(5)	Sun Oil Company	248	9,280 bbl.
(6)	Texas Gulf Producing Company	56	5,140 bbl.
(7)	Tidewater Oil Company	73	3,026 bbl.
(8)	Strake Petroleum, Inc	66	2,890 bbl.
(9)	Harrison & Abercrombie	36	2,135 bbl.
(10)	Alpha Petroleum Corporation	38	2,116 bbl.

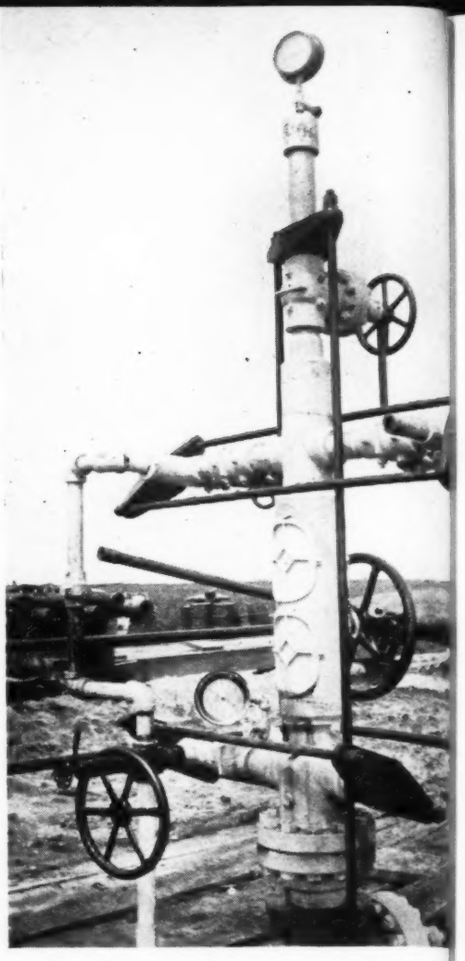
TOTAL ANNUAL CRUDE OIL PRODUCTION, COASTAL TEXAS

Year	Total (Barrels)
1901	3,593,000
1902	17,465,000
1903	17,454,000
1904	21,672,000
1905	29,855,427
1906	11,680,366
1907	11,389,000
1908	10,452,000
1909	8,766,000
1910	7,800,000
1911	7,272,000
1912	6,145,168
1913	5,824,000
1914	10,615,000
1915	17,422,000
1916	18,298,000
1917	21,281,000
1918	21,211,000
1919	25,169,000
1920	29,835,090
1921	37,654,000
1922	37,685,000
1923	33,612,000
1924	27,317,000
1925	31,158,000
1926	40,876,000
1927	48,589,000
1928	40,445,000
1929	50,392,000
1930	64,134,000
1931	48,032,000
1932	41,850,000
1933	61,002,000
1934	60,155,000
1935	64,323,000
Total	990,422,793

ranking producing company in Texas. Discovery of flank production at Spindletop by this company placed the company almost overnight in the ten million dollar class. Its sale to the Standard Oil Company of Indiana represented the highest-priced oil deal made in the history of Texas.

The Standard Oil Company of Indiana has had a phenomenal success in the Gulf Coast region since its entrance there in 1932. To date, out of five wildcat tests drilled, four resulted in discovery wells. However, the most important development by the Stanolind Oil and Gas Company in the Gulf Coast area to date is the Hastings oil field, discovered December 22, 1934, 14 miles south and slightly east of Houston, being southeast of the town of Pearland in northern Brazoria County. Their No. 1 J. W. Surface made an initial flow of 149 bbl. of 38-gravity oil per day from the Marginulina sand found from 5865 ft. to 5990 feet. The pressure recorded was 2150 lb. on the tubing and 2400 lb. on the casing. By the end of 1935, more than 40 wells had been completed and placed on production.

The deepest developed production in the Texas Gulf Coast salt dome region to date is the Hamman Exploration Company's No. 1 May Cleveland in the Hall survey of southern Matagorda



A high-pressure Christmas tree installation in the new Gillock pool of Galveston County. Coastal Petroleum Company's No. 1 Maco Stewart. Casing pressure was 2800 lb. when this photograph was taken

County. Initial production was 230 bbl. of oil and fluid per day produced through a $\frac{3}{16}$-in. choke from perforated liner from 9361 ft. to 9370 feet. The 7-in pipe had been cemented at 8350 feet. The pressure was 850 lb. on the tubing and 1100 lb. on the casing.

Previous to the Hamman-Lawrence discovery, the deepest developed production in the Gulf Coast salt dome region was Humble Oil and Refining Company's No. 1 Danielson and adjoining wells in the Dickinson oil field of Galveston County, productive from 9120 to 9140 ft., and placed on production in 1935.

In 1934, the record depth to the producing sand for the region was

Mud-conditioning material being used at a well in South Houston field. To protect the well from blowouts when drilling through high-pressure gas sands, so common in the salt dome fields of the Gulf Coast, the mud must be maintained continuously in proper condition

IN TIGHT SPOTS

TRIMO'S the wrench to use in the tight spots—when men's safety and company profits may depend on the way a pipe wrench takes hold.

TRIMO grips hard—on any job. Made throughout of Chrome Molybdenum Nickel Alloy Steel. TRIMO is the most durable pipe wrench known. Handle is drop forged steel.

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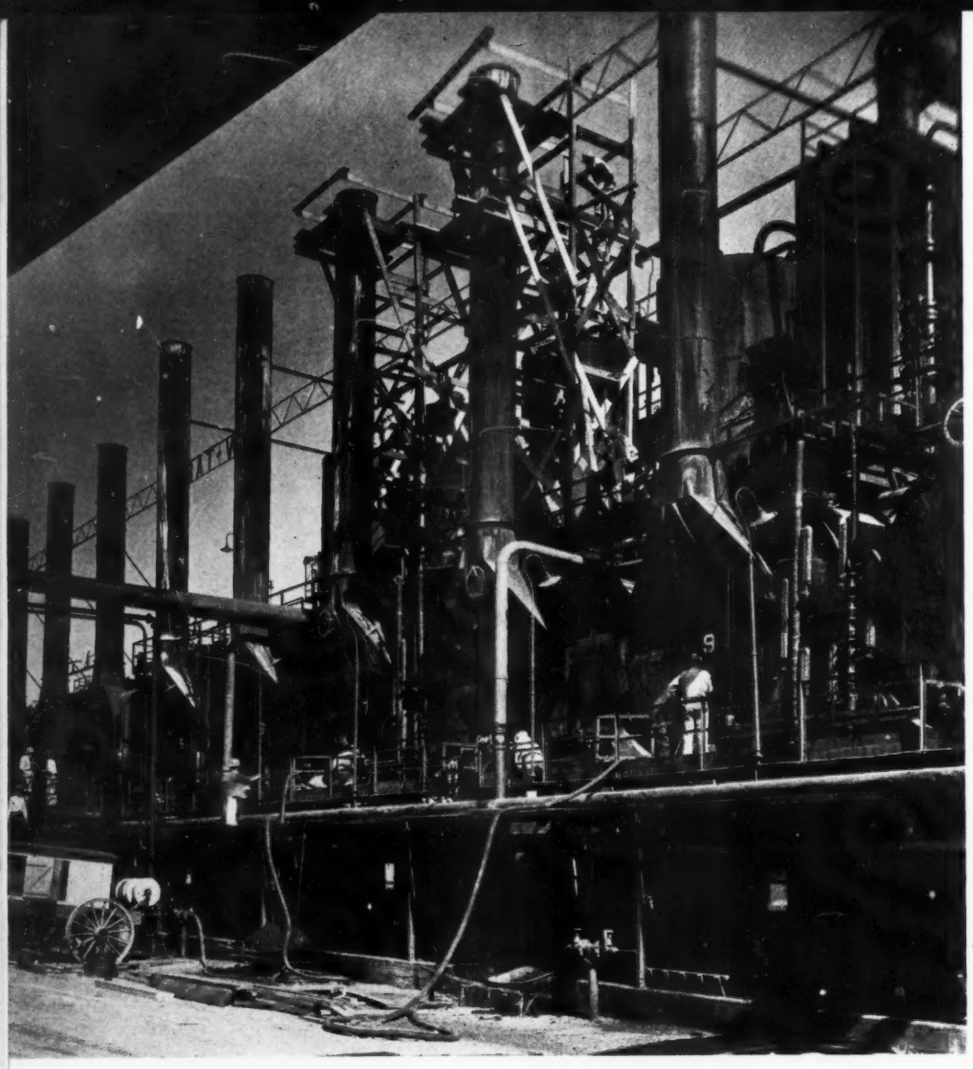

Close-up view of modern refinery stills. This photograph was taken at the Baytown refinery of the Humble Oil and Refining Company

8631 ft. at D. J. Harrison and J. S. Abercrombie's No. 1 Bernard Land and Development Company in the Charles Breen survey two miles northwest of Sweeny in southwestern Brazoria County and brought into production on November 10 of that year. The initial production was 504 bbl. of net oil per day found from 8631 to 8651 ft. in the Frio phase of the middle Oligocene.

In 1932, the record depth of pay sand was held by the old United North and South Development Company's two oil wells on the Buckeye structure in western Matagorda County where Marginulina production was found as deep as 7926 feet.

Deeper Possibilities. The future reserves of the Gulf Coast salt dome region lie in the Claiborne group of sediments of lower Eocene age. Already, production has been completed in the uppermost member of this formation, Upper Saline Bayou in the Esperson field of Liberty County, in the Orchard field of Fort Bend County, in the Katy gas field of southeastern Waller County, in the Hardin fault area of eastern Liberty County, Eureka, and the Humble oil field of northern Harris County.

Although possibilities exist in the Sparta sand member of the Claiborne group, the greater reserves are believed to lie in the Cook Mountain and Mt. Selman formations. In the Raccoon Bend field of eastern Austin County, Humble Oil and Refining Company's No. 11-X Woodley in the William Harvey survey, deepest test drilled to date on that dome encountered showings of oil from 7046 ft. to 7061 ft. in the Cook Mountain formation. On the East Bernard dome in northeastern Wharton County, C. B. Bunte and Rosemount Producing Company et al's No. 1 Janik heirs in the Jonathan Scott survey had a two-bbl. showing of 39-gravity oil (40 percent lubricating oil) and gas blew for two hours from the Mount Selman formation from a plugged-back depth of 8300 feet. In the Cleveland oil field of western Liberty County, Gulf Production Company's No. "C"-2 Kirby south of the discovery well is credited with having encountered oil showings in the Cook Mountain formation, but this well was abandoned at 8735 ft., after penetrating that formation for more than 1735 feet.

The Cook Mountain formation in the Kittrell oil field of southern Houston County, on another inland salt dome ridge, carries oil-saturated sands at 1085 feet; however, it is more than 100 miles north of Houston, being almost that distance outside of the main Gulf Coast salt dome region.

Marginulina Production. Second in importance as an oil-producing horizon in coastal Texas, next to the Frio of the Oligocene, is the Marginulina, which first came into the limelight with the discovery of the Thompsons field in Fort Bend County in 1931. Notable discoveries in this pay is the Hastings oil field of northern Brazoria County, discovered December 22, 1934, by the Stanolind Oil and Gas Company, and now evaluated at $200,000,000 by the Standard of Indiana subsidiary, the principal operator. Other important discoveries are the Manvel field, discovered in 1931 in northern Brazoria County by The Texas Company; the Pledger gas field discovered 1932; the Louise field of southwest Wharton County discovered 1933; the Buckeye field discovered in 1933 by the United North and South Development Company, and deeper production found in 1934 at Port Neches in Orange County by The Texas Company, likewise deeper production in 1934 by the Pure Oil Company at Lost Lake in Chambers County. In April, 1936, Humble Oil and Refining Company discovered Marginulina production at a shallower level in the Frio sand field at Anahuac in northern Chambers County. The Texas Company found Marginulina production at Pickett Ridge field near Wharton in Wharton County on June 24, 1935. Another important Marginulina discovery was made on December 4, 1935, at Turtle Bay in northern Chambers County by the Stanolind Oil and Gas Company. The Buckingham Oil Company opened up the first oil production for Aransas County April, 1936, when its No. 1 McCampbell blew into production from the Marginulina at 5624 ft. near the San Patricio County line on the shores of the Gulf.

DRILLING METHODS

Derrick Barges. Among the more significant developments in drilling methods effecting economy of time and labor is the use of the derrick

Unretouched Photo, Lease of Major Operator in East Texas Field.

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BEAUTY . . . *Combined with* Efficiency . . .

Attractive leases were little thought of until recent years. Now an attractive lease is considered as important as an attractive retail outlet. Oil men have been quick to appreciate the advantages of both.

Lufkin's efficient, trouble-proof equipment lends itself readily to attractive and well-kept leases such as the one reproduced above.

Catalogue No. 36 contains completely illustrated layouts with blue print setting plans and engineering data and will be gladly mailed to oil men anywhere upon request.

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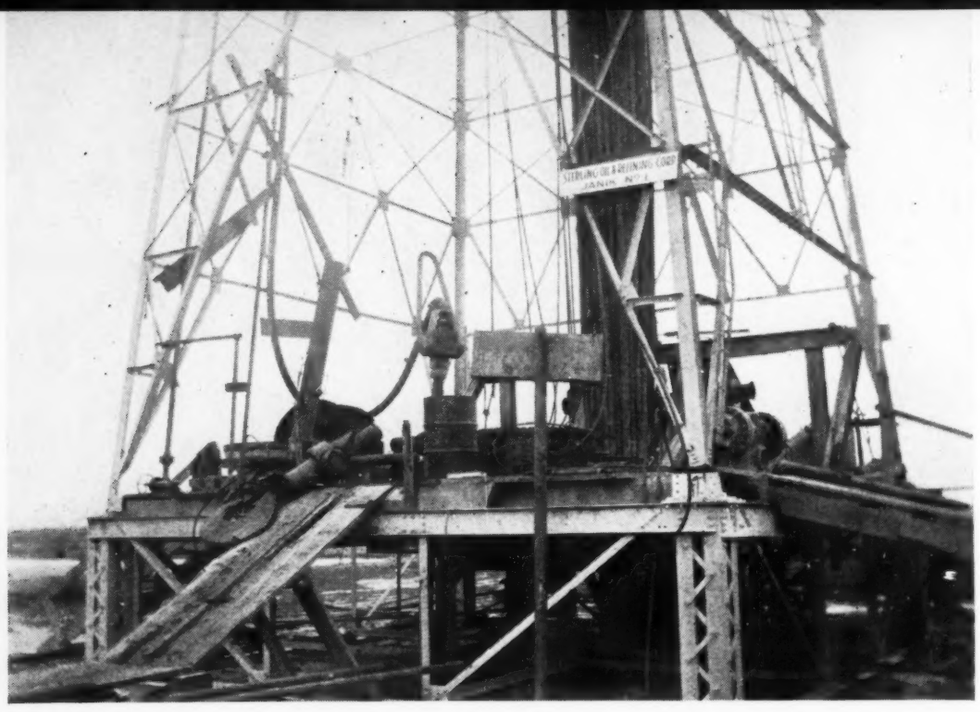


A typical heavy-duty rig used in drilling 8000-ft. wildcat tests on deep-seated structural domes in the Gulf Coast district

barge, a method employed for four years in Terrebonne Bay in coastal Louisiana. With development active at Turtle Bayou on Dickinson Bayou and with much geophysical prospecting scheduled for Galveston Bay and Bolivar Peninsula in Galveston County, this method of development probably will make its entry in Texas during 1936. Already Stanolind Oil and Gas Company has let contract for construction of two all-steel barges of this type. These will be 70 ft. long, 28 ft. wide and six ft. deep.

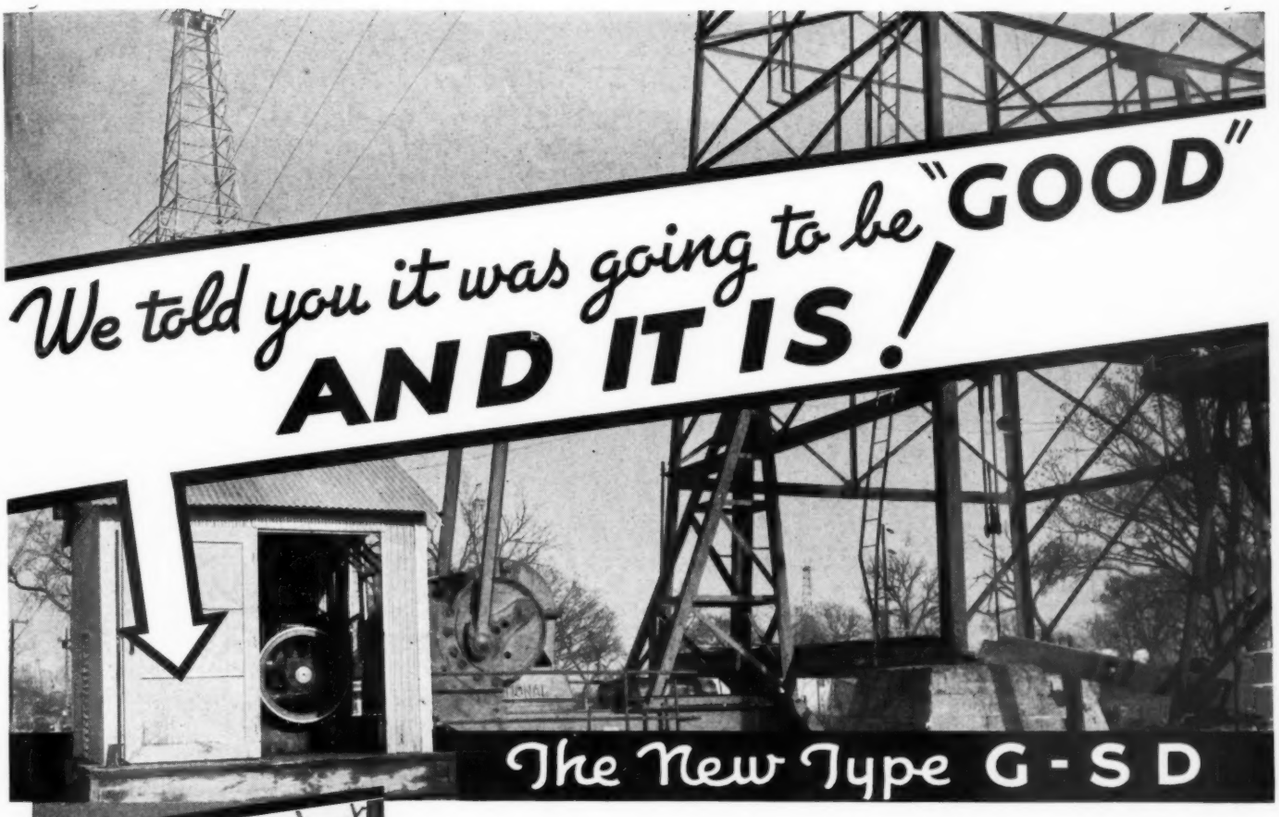
Heaving Shale Problems. The recent success of the Continental Oil Company in overcoming heaving shale drilling difficulties at its Seadrift prospect in Calhoun County in the coastal region likely will open the way for deep prospecting in those districts of the coast heretofore shunned because of the problem of drilling heaving shale. Continental Oil Company's No. 2-A Moody penetrated 1600 ft. of heaving shale, the top of which was found at 6150 ft., and then set a string of 8⅝-in. casing at 8020 feet. This operation is all the more remarkable because of its proximity to a well lost by heaving shale only 150 feet away. Hydration of the shale, chief cause of heaving, was prevented by the use of sodium silicate muds. Rapid

Mud-weighting colloidal material in use at a well in the Clarkwood field. Maintaining drilling mud at the proper weight and viscosity is necessary to prevent blowouts, possible damage to equipment, and interruptions in drilling

DAILY OIL PRODUCTION, TEXAS GULF COAST DISTRICT

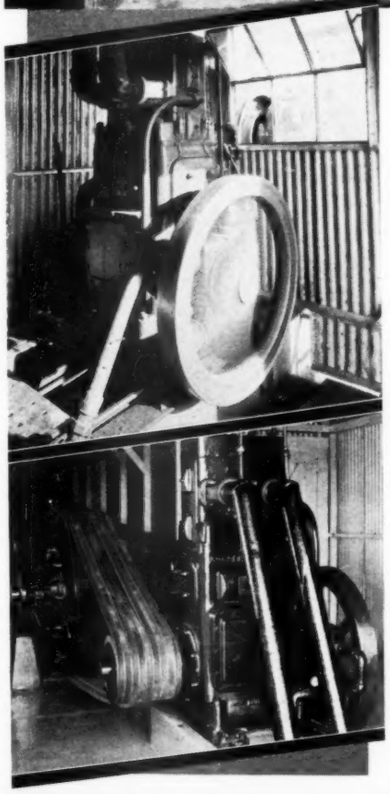
County	11-22-34 Daily Output	11-22-34 Total No. Wells	Cumulative Production to Jan. 1, 1934	11-22-34 Acreage Productive
Anderson	3,750	43	1,508,100†	
Austin	4,200	80	12,018,489	10,100
Bastrop	643	73	1,109,393	692
Brazoria	8,310	78	86,753,758	1,670
Calhoun		1		20
Chambers	19,800	137	38,115,348	350
Cherokee	310	8	2,974,000†	
Fort Bend	21,280	252	49,111,424	5,005
Galveston	7,100	42	5,518,291	450
Goliad				20
Hardin	4,350	492	139,336,323	2,065
Harris	15,080	435	216,540,521	8,535
Houston	150	3	28,924	25
Jackson	150	1		320
Jasper	10	3		
Jefferson	3,550	172	120,304,067	460
Leon		2		
Liberty	11,500	283	95,622,235	1,540
Matagorda	1,700	28	4,647,863	280
Milam	225	611	3,029,731	4,500
Montgomery	38,300	797	32,000,000	17,010
Orange	2,600	59	33,655,237	475
Polk	2,100	27	412,392	450
Refugio	17,450	4,257	1,304,204	21,534
Tyler		1		5
Victoria	550	5	141,986	580
Waller	100	2	2,500*	10
Washington	800	27	2,524,248	
Wharton	1,100	77	4,443,777	450
Williamson	710	336	5,937,073	925
Total	165,818	8,332	857,039,895	77,471
Royalty Income	20,727		107,129,887	

†To December 2, 1934.
*To November 22 1934.



We told you it was going to be "GOOD" AND IT IS!

The New Type G-S D



"BE SURE you are right. Then go ahead." That's what we did with this new Vertical Pumping engine. RESULT — field performance is even *better* than we predicted! Users are elated.

Field records PROVE that Type G-SD *slashes pumping costs.* Reasons? A whole score of them! For example, take these:

(1) Crosshead design cuts lube-oil consumption. (2) Better scavenging and operating economies. (3) Easier starting, less down-time, low maintenance expense — because of Timken main roller bearings, and pressure lubricating system. (4) Die-forged crankshaft and connecting rods, drilled for pressure lubrication.

Let our representative go over this *good engine* with you, point by point. Then you'll *know why* it is so convenient, so reliable, so economical! Meanwhile, send for folder.

TEXAS — photo at left shows Magnolia Petroleum Company's Type G-SD vertical gas engine, pumping J. C. Baldwin No. 1 and No. 2 wells near Clarkwood.

OKLAHOMA — photos at top and center show Carter Oil Company's Type G-SD vertical gas engine, pumping No. 2 well in Oklahoma City field.

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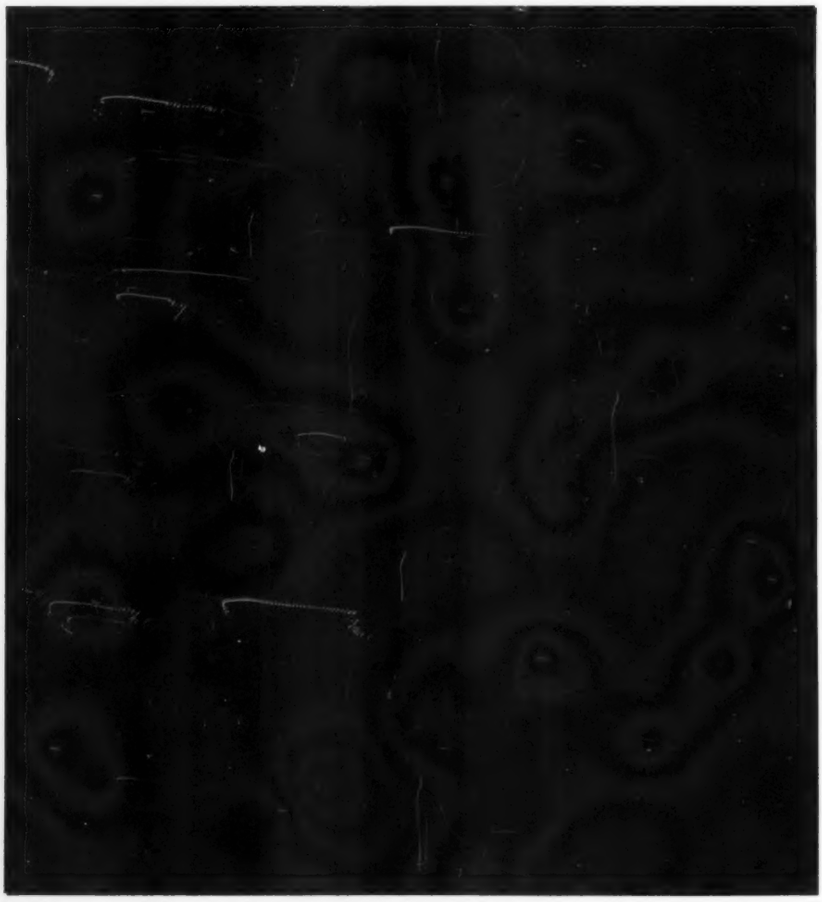
Showing the network of pipe lines of The Texas Pipe Line Company in Texas. Also shown is location of The Texas Company's refineries in the state

chemical precipitation resulting from its use instantly seals the shale, rendering it impervious to water.

By using extremely heavy-duty drilling equipment it insures continuous circulation, the key to successful drilling through the heaving shale. Geologically, the heaving condition was found in the uppermost Oligocene (Discorbis, Heterostegina and Marginulina).

Rig Equipment. Deeper drilling in the coastal region is now characterized by the trend toward higher boiler pressures, some installations having a working pressure as high as 350 lb., although 250 lb. working pressure is considered adequate for the average 8000-ft. test. Boilers having a rating of 125 hp. are now standard in the Gulf Coast. Super-heated steam is used by many operators. Other improvements in operations to meet the requirements of drilling to 10,000 ft. include the use of the 136-ft. steel derrick, 14 by 14 twin drilling engines, unitized drawworks, turbine-driven mud pumps that at 3600 r.p.m. develop 200 horsepower.



Trunk line system of Magnolia Pipe Line Company in Texas

Electrical Surveying. In many localities it is standard practice to drill to the contract depth, then make an electrical survey of the bore hole to determine the oil and gas strata penetrated by measurement of the electrical resistivity in ohms, and porosity in millivolts. So highly developed is this method, that several major companies correlate structure by comparing Schlumberger well logs and noting the interval and character of electrical peaks.

Drilling Piers. The use of drilling piers was first adopted in coastal Texas during 1935. Stanolind Oil and Gas Company installed piers for its No. 1 State on Turtle Bayou, south of its No. 1 Middleton, discovery well in Chambers County; also for its Nos. 1, 2, and 3 State on Dickinson Bayou in Galveston County.

Perforated Casing. Greater efficiciency in production, reduction of water intrusion, and gas sand shutoffs are effected through intelligent use of the perforated casing method of completion. After the pay zone is thoroughly cored and measured, the production string is set on bottom. By means of the gun-perforator, and after checking cores and the Schlumberger electrical log, operators may have holes shot in the formation through the casing opposite the most prolific pay strata, usually ten holes (staggered) to each foot of formation.

"BANK ON INTERNATIONAL"

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International Model C-55-F dual-drive six-wheel truck owned by T. E. Collins, Shreveport, La., ready to haul this drawworks to location. International Trucks range in size from the Half-Ton unit to these powerful Six-Wheelers.

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YOUR most reliable guide when you buy motor trucks, industrial tractors, or power units is the opinion of users as to *International against the field.*

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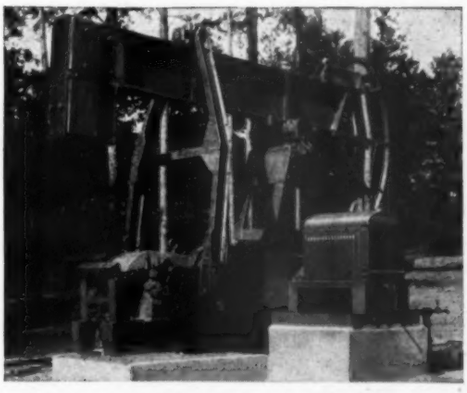
Vast numbers of successful installations of International Trucks, Tractors, and Power Units throughout the industry are your guarantee that this Company will give you the soundest, most profitable answer to your own hauling and power problems. Cash in on International Harvester *experience,* and on the protection afforded this equipment by International Harvester *service.*

Call on the nearest Company-owned branch, or International dealer, for information. Catalogs sent on request.



An International Power Unit, using natural gas as fuel, pumping on the Lulu May Baker lease at Johntown, Texas. International Power Units range from 12 to over 100 h.p., and there are engines from 1½ to 5 h.p. for light-duty service.

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Thus water sands are kept sealed, gas sands are shut-off until needed, and only the most prolific sections of the oil-bearing formation are selected for production. Great success has been noted with this method in the Plymouth field of San Patricio County near Corpus Christi.

GEOPHYSICAL OUTLOOK

Bay and Tideland Exploration. Exploration of bays and tidelands, initiated three years ago in southern Brazoria County by the Amerada Petroleum Corporation, probably will have major attention during 1936. Already the Salt Dome Oil Company and the California company have begun a systematic geophysical exploration of more than 60,000 acres comprising Galveston Bay, extending from the Red Bluff district near Seabrook to the mouth of the Trinity River near Anahuac. The party operates out of Barbours cut at Morgans point.

A fleet of ten boats, the majority of which were leased from bayshore boat owners, carry the party of 40 to and from the scene of explorations. Personnel includes 17 seismologists and assistants, 12 boat tenders, mechanics, and cooks.

Difficulties. In many parts of the Gulf Coast where gravel beds extend sometimes to at least 100 ft. in depth, shot points are drilled across a profile line with a light-duty rotary, and cased with 3-in. pipe. Unless this is done, the presence of the gravel distorts the shots, giving incorrect velocities to the recording instruments. Routine practice utilizes shot points 40 ft. in depth drilled by regular core-drill trucks.

Major companies have adopted the practice during the last three years of utilizing the deep tests drilled in exploration work for geophone tests to determine the wave velocities, since the well depth already is obtained by steel line measurements. The geophone is lowered on a swab line to the bottom of the hole and a charge of dynamite detonated at the surface.

Interpretation. Correlation of unusual seismic "pictures" with those of known deep-seated domes is making possible improvement of interpretation technique in recognizing anomalies of deep-seated domes; aided by correlation with regional minima as shown by torsion balance work. The gravity pendulum is finding use as an auxiliary aid.

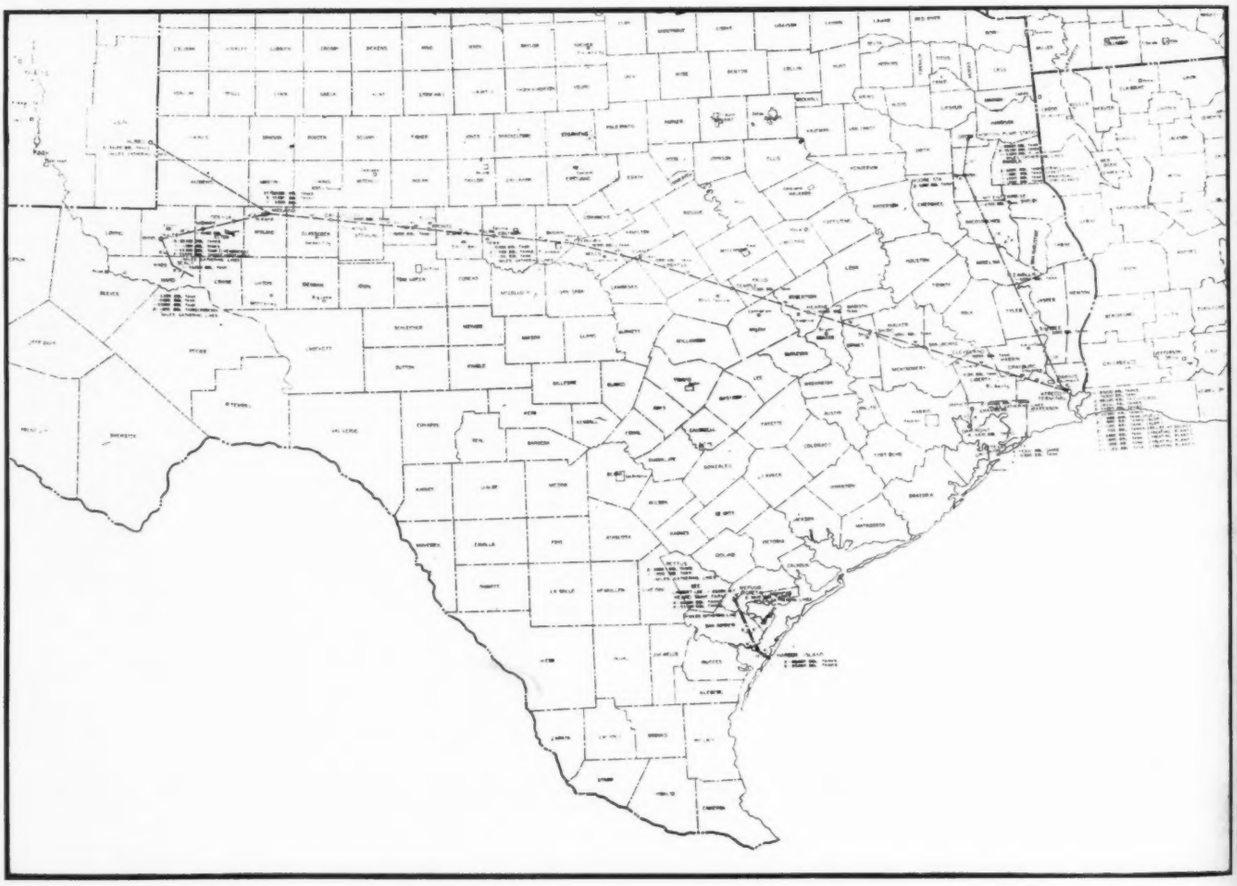
REFINING

One of the largest oil refining centers in the nation is in the coastal portion of Texas, within a 70-mile radius of Houston. Here the bulk of more than $400,000,000 has been spent since Spindletop in construction and enlargement of plants, some of which have a capacity of 100,000 bbl. daily.

Early History. The forerunner of the Port Arthur unit of the present Gulf Oil Corporation, was first erected in 1902 by J. M. Guffey, whose plant ran on 3-cent to 4-cent crude and had a crude capacity of 7500 bbl. per day. In the fall of that year, Guffey expanded the capacity of his plant to 24,000 bbl. daily, after W. L. Mellon and his associates financed a $5,000,000 bond issue for plant enlargement. Today the Port Arthur refining, with its 6000 acres, occupies an area larger than Manhattan Island. Some 280 stills and 2000 tanks are used in the operation of this gigantic tidewater refinery.

In May, 1902, J. S. Cullinan erected a refinery at Port Arthur after he had

Total tankage, gathering, and trunk lines of Atlantic Pipe Line Co. Scale: Approximately 1 in. = 20 miles



completed construction of 375,000 bbl. of steel storage at Spindletop.

Late in that year, George A. Burt erected a plant southwest of Beaumont, which changed hands in May, 1903, for a consideration of $5,000,000. The purchaser was the Security Oil Company, forerunner of the Magnolia Petroleum Company.

Shortly afterwards, Colonial Oil Company erected a small plant at Port Arthur. The following year an asphalt plant was installed at Port Neches near Beaumont. Other installations were made by the United Oil and Refining Company.

In the Houston district of the Texas Gulf Coast, 11 major refineries are in operation, and have a total daily capacity of 565,000 bbl., which, together with the capacity of lesser refineries of 100,000 bbl. daily, makes a total of more than 650,000 barrels.

These refineries are as follows:

The Port Arthur plant of The Texas Company with a daily capacity of 65,000 barrels.

The Port Neches plant of The Texas Company with 20,000 bbl. daily capacity.

The Houston plant of The Texas Company with a capacity of 20,000 barrels.

The Texas City plant of the Pan-American Refining and Transport Company (subsidiary of the Standard Oil Company of Indiana) with a daily capacity of 40,000 barrels.

The Houston Ship Channel plant of the Shell Petroleum Corporation at Deer Park, with a daily capacity of 56,000 barrels.

The Houston Ship Channel plant of the Sinclair Refining Company with a daily capacity of 55,000 barrels.

The Nederland plant of the Pure Oil Company, with a daily capacity of 26,000 barrels.

The Beaumont plant of the Magnolia Petroleum Company with a daily capacity of 70,000 barrels.

The Port Arthur plant of the Gulf Refining Company with a daily capacity of 100,000 barrels.

The Baytown plant of the Humble Oil and Refining Company on the Houston Ship Channel with a daily capacity of 90,000 barrels.

The Ingleside plant of the Humble Oil and Refining Company with a daily capacity of 12,000 barrels.

COASTAL CRACKING PLANTS

Almost 480,000 bbl. of cracking capacity is installed among 18 refineries in the coastal Texas region. Of these, eight along the Houston Ship Channel have a total cracking capacity of 147,000 bbl.; two at Port Arthur have a total capacity of 150,000 bbl.; two at Texas City have a capacity of 9000 bbl.; one at Nederland has a capacity of 30,000 bbl.; one at Beaumont has a capacity of 60,000 bbl.; one at Corpus Christi has 55,000 bbl. capacity; at Ingleside one installation has a capacity of 8000 bbl.; and at Atreco one installation has 20,000,-bbl. capacity.

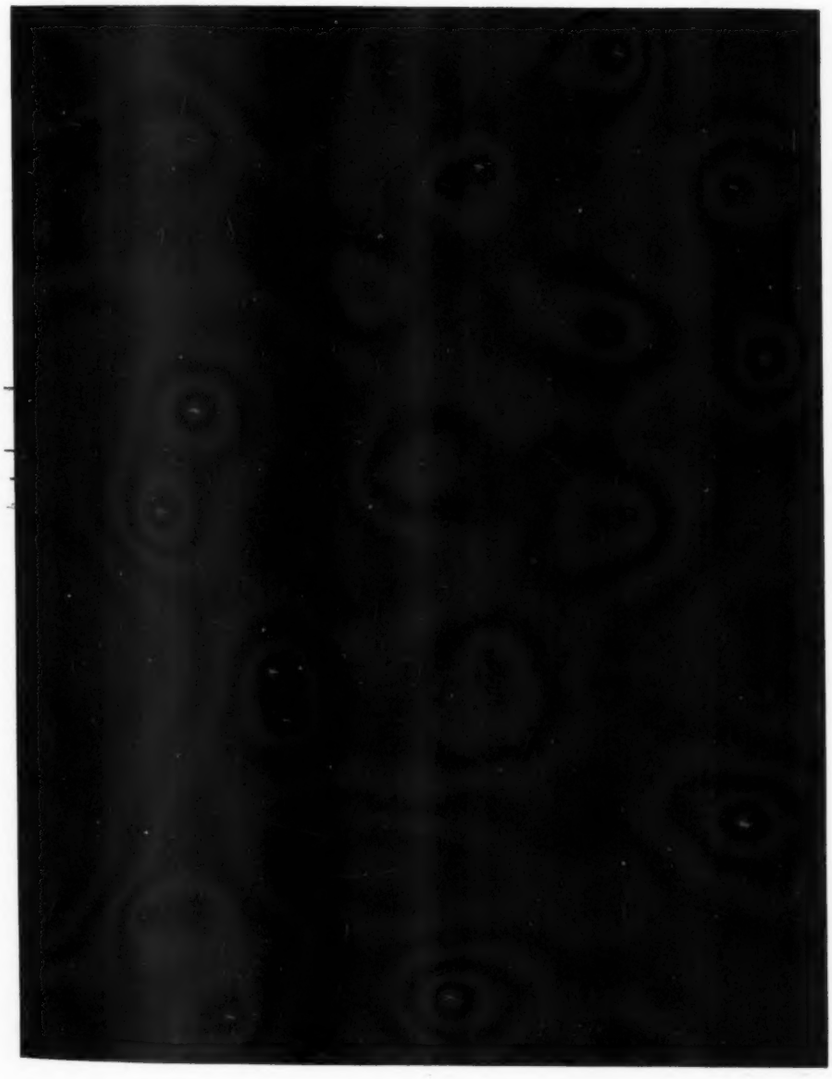
To meet the demand for its Havoline lubricating oil, heretofore produced at its Lawrenceville, Illinois, plant, The Texas Company has erected equipment for a 3000-bbl. solvent dewaxing process and a 4000-bbl. solvent refining plant.

Airplane fuel, of 100-octane rating, is being produced through polymerization of refinery gases, followed by hydrogenation, at an installation in the Deer Park plant of the Shell Petroleum Corporation on the Houston Ship Channel.

During 1935, Magnolia Petroleum Company at Beaumont, placed in operation a 2000-bbl. solvent plant for production of lubricants.

Use of the sulphur dioxide solvent refining process has been highly successful with the Humble Oil and Refining Company at its Baytown plant on Galveston Bay. The Baytown plant, served by an 8-in. pipe line that supplies butane, propane, and natural gasoline, is utilizing polymerization in manufacture of airplane fuel for the Standard Oil Company of New Jersey markets.

A 5000-bbl. refinery was completed at Port Isabel in eastern Cameron



Texas oil lines of Humble Pipe Line Company

County in southwest portion of the state, serving principally as an outlet for the Sam Fordyce field of Hidalgo County where 124 oil wells have been brought in since September, 1934.

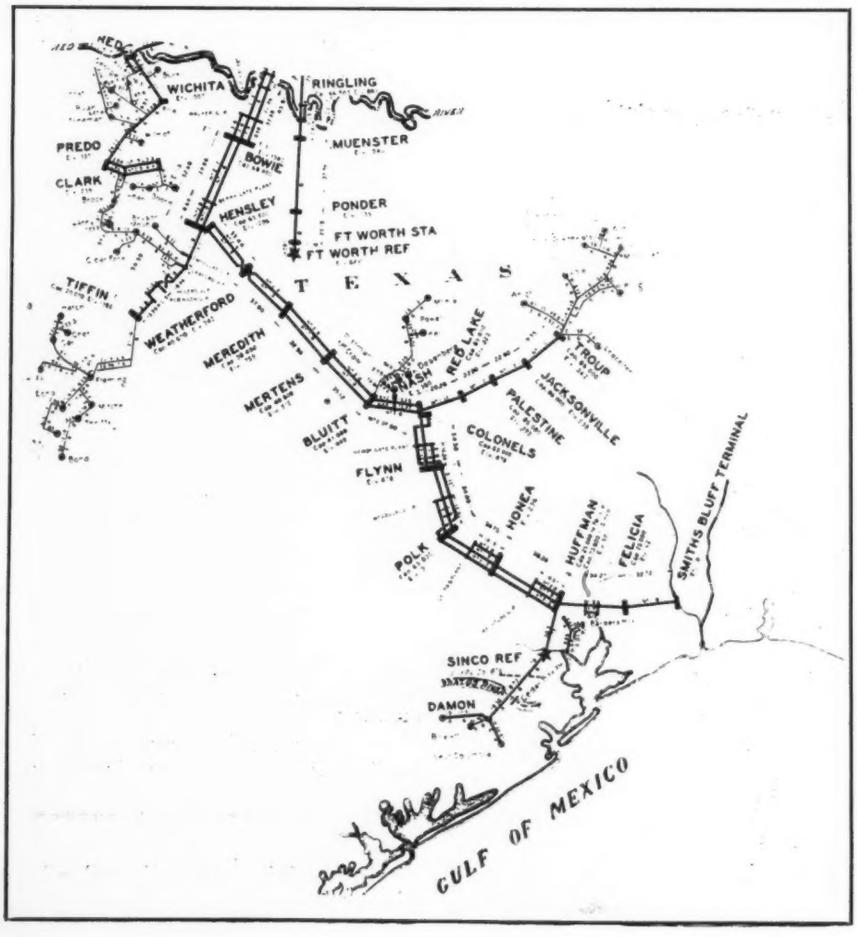
NATURAL GASOLINE PLANTS

A total of seven natural gasoline plants having a total daily capacity of 203,000 gal. serve the coastal Texas region. These are situated in Montgomery, Brazoria, Harris, Refugio, and Nueces counties, the largest installations being at Refugio, Conroe, and Pasadena.

The following is the latest tabulation of the group (alphabetical):

Town	County	Company	Capacity
Agua Dulce	Nueces	Clymore Gasoline Company	18,000 gal.
Conroe	Montgomery	Midland Gasoline Company	25,000 gal.
Conroe	Montgomery	Humble Oil and Refining Co.	30,000 gal.
Pasadena	Harris	Phillips Petroleum Company	35,000 gal.
Pledger	Brazoria	Paramount Gasoline Company	25,000 gal.
Refugio	Refugio	United Gas Public Service Co.	30,000 gal.
Refugio	Refugio	United Gas Public Service Co.	40,000 gal.
Five Towns	Five Counties	Seven Plants	203,000 gal.

The natural gasoline industry in the coastal Texas region dates from 1923 when the first export cargoes of unblended material were shipped to an European market. Among the leaders in the natural gasoline trade in the Gulf Coast is the Warren Petroleum Company of Tulsa and Houston, which maintains extensive terminals at Houston. With the discovery of the Conroe oil field in Montgomery County in 1931, Humble Oil and Refining Company built a 30,000 gal. plant, one of the largest in the coastal region. This was later exceeded in capacity by the United Gas System's plant of 40,000-gal. capacity originally constructed at Refugio by G. Clymore subsequent to 1934 on the discovery of that field.



Sinclair Prairie Pipe Line Company's trunk and feeder lines in Texas

PIPE LINES

Early History. One of the first pipe lines laid to tidewater following the spectacular Spindletop discovery was a 20-mile 6-in. oil line from the new field at Beaumont to Port Arthur, by The Texas Company. That company built a similar line to Sour Lake, an extension of its Port Arthur to Spindletop line. As the new shallow salt dome fields of the Spindletop area were brought into production, The Texas Company extended its lines later to Saratoga, another ten miles, and in 1906 made another 50-mile jump to Humble in northern Harris County. A 20-mile line was laid shortly thereafter from Humble to Houston in the same county.

About the same time, the J. M. Guffey Petroleum Company had constructed 6-in. lines from Sour Lake to Saratoga and to Batson. But with the organization of the Gulf Pipe Line Company of Texas in November, 1906, an 8-in. line was laid from Watkins, Oklahoma, in the heart of the Glenn Pool to Sour Lake in Hardin County where it connected with the 6-in. line already laid by the Guffey concern.

The next main trunk line to be laid to the Gulf Coast was constructed early in 1912 by the Magnolia Petroleum Company from Electra in Wichita County, north Texas, by way of Corsicana to Beaumont. It was of 8-in. pipe. December 16, 1913, the Magnolia Pipe Line Company was organized and took over operation of the new line.

Post-World War Period. With the discovery of gusher production at West Columbia in western Brazoria County in 1918, Humble Pipe Line Company laid an 8-in. line to tidewater. When the Pierce Junction oil field development southwest of Houston in Harris County had developed to a sizable stage, Humble laid an 8-in. line the same year to this field

At the close of the World War, Humble Pipe Line Company constructed an 8-in. line from its Comyn station in Eastland County, West Central Texas, to Baytown, on Galveston Bay southwest of Houston. About ten years later, Humble increased the capacity of the Webster to Hearne section of its main line from 20,000 to 100,000 bbl. per day.

About 1924, Atlantic Pipe Line Company laid a trunk line from Midland to Port Arthur.

Shell Petroleum Corporation ex-

tended its West Texas trunk line system in 1926 from the Hendricks field to tidewater at Houston.

Developments in 1933. One of the most important coastal lines was the 47-mile oil line built in 1933 from Hufsmith station at Tomball in northern Harris County, extending southeast to the Baytown refinery of the Humble Oil and Refining Company on the Houston Ship Channel. This line, of 10-in. welded construction, has a daily capacity of 40,400 barrels.

Sinclair Prairie Pipe Line Company in 1934 assured ample crude to the Houston Ship channel refinery of the Sinclair Refining Company by constructing a 26-mile 12-in. line from Huffman station to Houston.

Stanolind Pipe Line Company in 1933 laid a 33-mile 12-in. welded line to the Texas City refinery of Pan-American Refining and Transport Company from Sinco, a terminus of its trunk line.

An cutlet to the north for the Tomball field was completed in 1933 by the Magnolia Pipe Line Company. An 8-in. line, 16 miles in length, was laid to its Corsicana main line.

Developments in 1935. The first pipe line outlet for the new Anahuac oil field of northern Chambers County was constructed by the Humble Oil and Refining Company, which laid 12 miles of 6-in. pipe to connect at Moss Bluff with its main line extending through the Barbers Hill field to the Humble refinery at Baytown.

A 9000-bbl. feeder line was laid by the Stanolind Pipe Line Company of Tulsa, Oklahoma, from the new Hastings oil field in northern Brazoria County eastward to the town of Webster. At that point, it ties in with the Pan-American Pipe Line Company's (subsidiary of the Pan-American Refining and Transport Company) 12-in. trunk line extending from Mexia to Texas City. Pan-American has a 40,000-bbl. refinery at Texas City the cracking facilities of which recently have been expanded. More than 22 oil wells were completed during 1935 by the Stanolind Oil and Gas Company to supply this line, each well being allowed 150 bbl. per day under proration restrictions set by the Railroad Commision of Texas.

From the new Mauritz oil field of eastern Jackson County, where it joins with Matagorda and Wharton counties, south of the Louise oil field, Shell Pipe Line Company constructed a 4-in. line 14 miles in length to the town of Clemvell near Markham in northern Matagorda County. There it ties into the 8-in. trunk line of The Texas Pipe Line Company that extends northeastward to Houston.

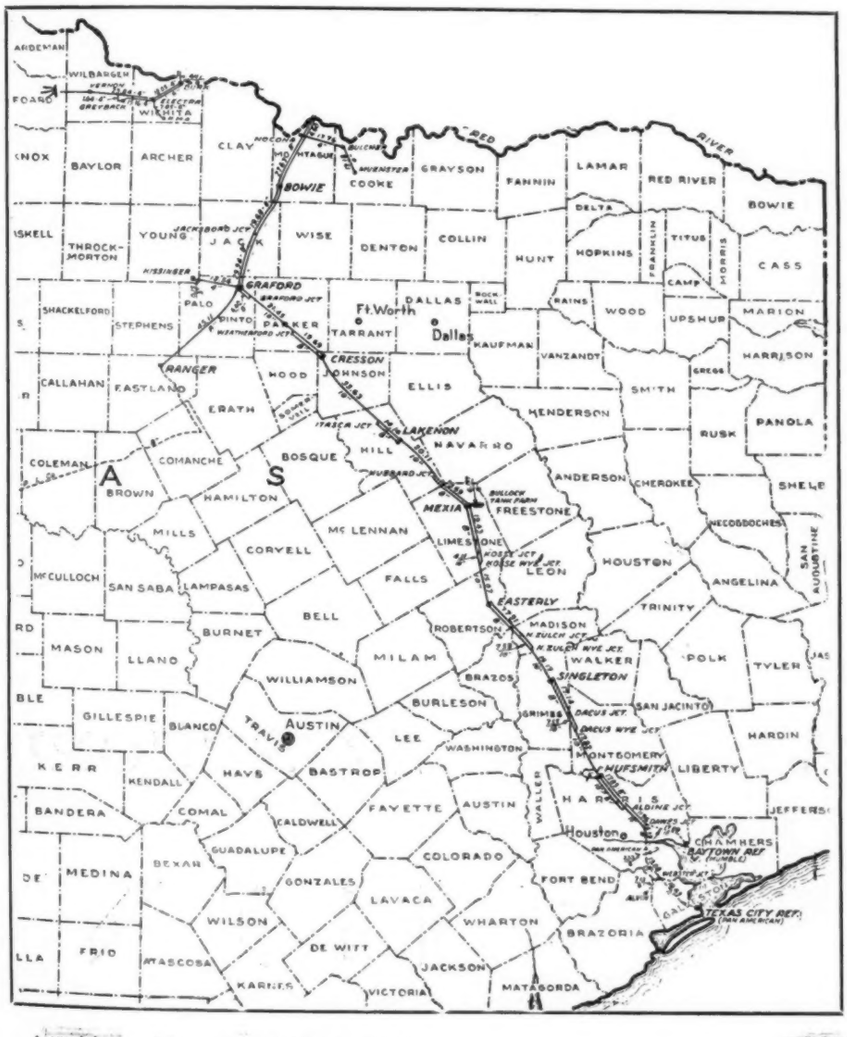
Accelerated development of the Dickinson oil field of Galveston County brought out the laying of a 4-in. line by the Humble Pipe Line Company to its main 8-in. line at Webster. This replaced a 2½-in. line extending the same distance. From Webster the Humble trunk line extends to Texas City.

An idea of the total intangible value of pipe lines throughout the State of Texas may be gained from the fact that the preliminary value recently released showed a valuation in excess of fifty-eight million dollars. Highest value was given to the Sinclair-Prairie Pipe Line Company of Texas with a valuation of $10,306,000; a valuation of $9,763,000 to Humble Pipe Line Company; and a valuation of $5,568,700 to Atlantic Pipe Line Company.

For purposes of assessment the principal pipe line companies are divided into three groups: (1) companies that operate systems of pipe lines affording transportation service from more than one oil-producing area to several terminals and connecting carriers; (2) companies that are providing transportation service from only one oil-producing area to one terminal; and (3) those companies that cannot be fitted into either of the other groups of companies. The assessments for 1936 were as follows:

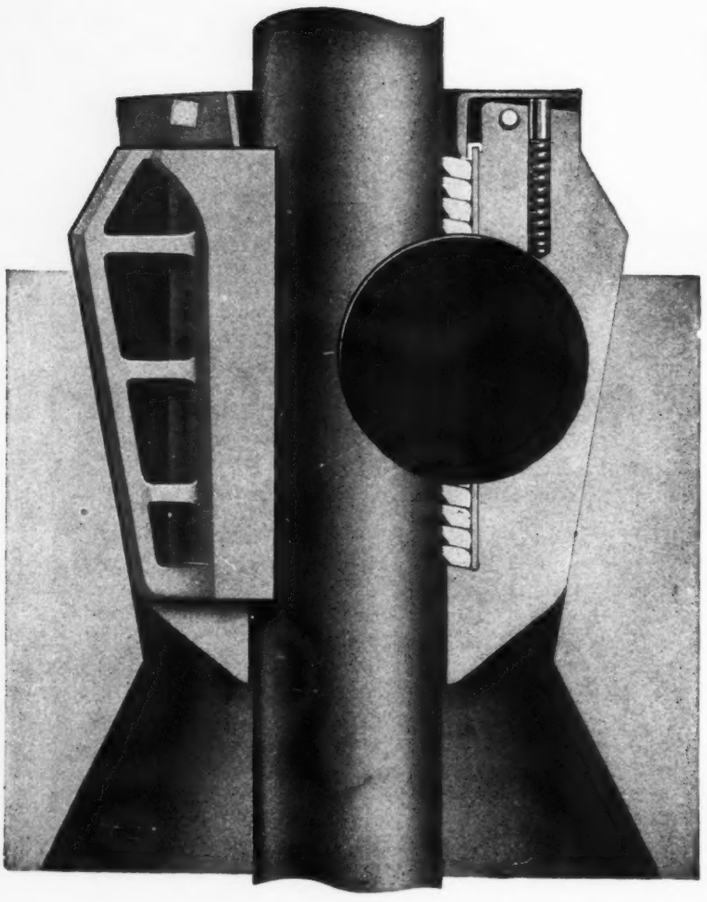
GROUP (1)

Atlantic Pipe Line Co.	$5,568,700
Gulf Pipe Line Co.	2,200,000
Humble Pipe Line Co.	9,763,000
Magnolia Pipe Line Co.	5,444,000
Shell Pipe Line Corp.	3,930,000
Sinclair Pipe Line Co. of Texas	10,306,000
Sinclair Prairie Pipe Line Co.	100,000
Texas Pipe Line Co.	7,183,000



Stanolind Pipe Line Company's lines in Texas

The UNIQUE



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» » » » » THE WORLD OVER

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HUMBLE ROAD . . . . . HOUSTON, TEXAS

Sold by Supply Stores Everywhere

Shell Pipe Line Corporation's system in Texas

GROUP (2)

Arkansas Pipe Line Co.	$ 276,400
Empire Pipe Line Co.	164,600
Pure Transportation Co.	2,483,000
Standish Pipe Line Co. (Phillips)	60,000
Sun Pipe Line Co.	1,422,000
Texas Empire Pipe Line Co. of Texas	2,898,500
Tidal Pipe Line Co.	782,800
Yount-Lee Pipe Line Co.	1,381,000

GROUP (3)

Pan-American Pipe Line Co.	$ 350,000
Toronto Pipe Line Co.	475,000
Valley Pipe Line Co.	70,000
F. H. E. Pipe Line Co.	150,000
Eastern Tex. Petroleum Co.	108,000
Republic Pipe Line Co.	400,000
Channel Transport & Marketing Co.	800,000
Federal Pipe Line Co.	50,000
International Pipe Line Co.	100,000
Pasotex Pipe Line Co.	390,000
Stanolind Pipe Line Co.	250,000
Reagan County Purchasing Co.	1,500,000

An example of the immensity of this huge system of industrial arteries is shown from the fact that five trunk lines lead from the West Texas and Southeastern New Mexico to tidewater at Houston, the Houston Ship Channel and the Port Arthur refineries on the Gulf Coast. Other major lines lead to refineries and terminals at Corpus Christi and Point Isabel on the Gulf.

MARINE TERMINALS

With nine terminals on the Houston Ship Channel, Houston commands a ranking position as a terminal center. There the following companies have wharves: American Petroleum Company, Clarion Oil Company, Crown-Central Corporation, Galena-Signal Oil Company, Gulf Refining Company, Humble Oil and Refining Company, Shell Petroleum Corporation, Sinclair Refining Company, and The Texas Company. In addition, six tank farms are situated near the Channel, representing pipe line terminals, as follows: American Petroleum Company, Clarion Oil Company, Gulf Pipe Line Company, Houston Oil Company, Magnolia Petroleum Company, Rio Bravo Oil Company.

Elsewhere on the Gulf Coast, large facilities are owned by the Gulf Refining Company at Port Arthur, by The Texas Company at Port Arthur, by the Humble Oil and Refining Company at Ingleside, by Stanolind on the Port Neches River at Beaumont (formerly owned by the Yount-Lee Oil Company), and by the Valley Pipe Line Company at Port Isabel, in eastern Cameron County, Southwest Texas.

The Stanolind Oil and Gas Company's loading terminal on the Neches River has a capacity of 10,000 bbl.

Gulf Pipe Line Company's network of oil lines in Texas

SURVEY OF OIL INDUSTRY TRAFFIC AT THE PORT OF HOUSTON MONTH OF NOVEMBER, 1934

Total Exports		$ 3,736,302
Total Imports		287,484
Coastwise Traffic:		
Inbound from Atlantic Ports	$ 37,735	
Inbound from Gulf Ports	457,904	
Inbound from Pacific Ports	88,960	
Inbound from Intracoastal Canal	23,780	
Total Inbound Coastwise Traffic		618,379
Outbound to Atlantic Ports	$10,758,773	
Outbound to Gulf Ports	1,394,769	
Outbound to Intracoastal Canal	7,505	
Total Outbound Coastwise Traffic		12,161,047
Local Traffic (including bunker oil)		588,949
Total Monthly Traffic (Petroleum industry)		$17,392,992

SURVEY OF OIL COMPANY FACILITIES ON THE HOUSTON SHIP CHANNEL

Company	Wharves (length)	Tank Farms	Oil Refineries (Daily Crude Capacity) Bbl.
American Petroleum Company	150	1	1,500 bbl.
Channel Petroleum and Marketing Company	.....		
Clarion Oil Company	150	1	
Crown-Central Corporation	300		10,000 bbl.
Galena-Signal Oil Company	300		
Gulf Refining Company	590		
Gulf Pipe Line Company	.....	1	
Houston Oil Company	.....		1,000 bbl.
Houston Oil Terminal	.....	1	3,000 bbl.
Humble Oil & Refining Company	1,400		125,000 bbl.
Maritime Oil Company	.....		
Magnolia Petroleum Company		1	
Phoenix Refining, Inc			1,000 bbl.
Phillips Petroleum Company			.....
Rio Bravo Oil Company		1	
Russell Oil Company			1,000 bbl.
Shell Petroleum Corporation	2,000		22,000 bbl.
Sinclair Refining Company	1,400		32,000 bbl.
The Texas Company	1,400		20,000 bbl.
Asphalt.			

NOTE—According to the latest report available from the United States census bureau, the total annual value of refined petroleum products is $131,876,649. Total wages paid per annum to 4884 oil refining workers on the ship channel is $6,707,900, according to the last report on file.

of oil per hour. Other high capacities are in evidence at the Houston Ship Channel facilities of the Humble Oil and Refining Company at Baytown and the Shell Petroleum Corporation facilities at Deer Park on the channel, the latter having a loading capacity of 30,000 bbl. per hour.

Exports of petroleum products and equipment are handled from the Port of Houston to 16 foreign countries, including the Argentine, Belgium, British Isles, Canada, China, Colombia, Denmark, France, Germany, Holland, Italy, Japan, North Africa, Puerto Rico, Sweden, and the West Indies (Dutch). Imports of crude oil are from Colombia, and fuel oil is from the Dutch West Indies. Fullers earth is imported from Belgium and the British Isles.

Not only is the Houston area on the Texas Gulf Coast one of the largest refinery centers in the world, but a leader in terminal facilities. How great is traffic in outbound crude oil in the Gulf Coast district of Texas may be noted from the fact that during 1935 half of the Mid-Continent's production was handled there. In this region, the principal shipping ports are: Port Arthur, Texas City, Baytown, Houston, Ingleside, Corpus Christi, Pt. Isabel. Considerable traffic also is handled via the intercoastal canal in Louisiana as well as Texas. Important terminals are those of the Gulf Oil Corporation of Pennsylvania at Port Arthur, The Texas Company at Sabine Lake, The Pure Oil Company at Smiths Bluff on the Neches River, and The Magnolia Petroleum Company at Beaumont on the Neches River. At Beaumont, the Stanolind Crude Oil Purchasing Company operates the old Yount-Lee terminal. At Neches, a small terminal is handled by the Humble Pipe Line Company, which organization also maintains a terminal at Baytown. Loading berths for two ships feature the terminal of the Atlantic Pipe Line Company at Atreco, terminus for its West Texas to Houston area trunk line. Loading speeds reach 20,000 bbl. of crude oil per hour. At Sabine Pass, the Sun Pipe Line Company maintains a terminal. All told, there are 25 terminals existent in the Upper Gulf Coast district with facilities for loading 27 tankers simultaneously. In this district 11 refineries maintain their own loading docks for ocean tankers.

At Texas City, terminals include those of the Atlantic Pipe Line Company, Continental Oil Company, Humble Pipe Line Company, Independent Terminal Company, Southport Refining Company, Republic Oil and Refining Company, Pan American Petroleum and Transport Company, and Hartford Products Company.

At Lynchburg, a crude oil terminal is operated by the Gulf Pipe Line Company.

Channels for intercoastal operations are contemplated by the Humble Oil and Refining Company and the Pan American Petroleum and Transport Company between Texas City, Baytown, and the High Island field.

MARINE TRANSPORTATION

Gulf Oil Corporation. Typical of development in the marine departments of oil companies is that of the Gulf Oil Corporation. Established in September, 1902, its fleet at the time comprised only 81,000 bbl. capacity, composed of one steamship, two sea-going barges, two tugs, and eight harbor barges. In a span of 33 years, reflecting steady growth, this fleet has developed to 22 steamships, six motorships, two sea-going barges, 11 power boats, 12 river barges, 24 harbor barges, three tugs and two dredges, with a capacity of 2,412,000 barrels. By 1936, it was 30 times greater than in its pioneer month at Spindletop. One motorship alone, the M. S. Gulfpride, with rated capacity of 150,000 bbl. of bulk oil, almost doubles the 1902 capacity of the entire Gulf fleet. The peak year for the Gulf was 1929 when 74,500,000 bbl. was handled. Direct employment at present is afforded to 1230 men.

The Texas Corporation. One of the largest oil tankers afloat and in use in the Texas Gulf Coast trade is the M. S. Brazil of The Texas Company, handling petroleum from South American ports. This huge tankship has a crude oil capacity of 100,000 bbl. in addition to a dry cargo space of 34,500 cubic feet. Its total overall length is 477 feet. Its twin Diesel engines are capable of supplying enough power to drive this colossus at an average speed of 11 knots per hour. A crew of 31 is required to man it.

GUIBERSON
Oil Savers

TYPE C-2 HIGH-PRESSURE TUBING AND DRILL PIPE OIL SAVER

Safe-Efficient!

GUIBERSON now manufactures the most complete line of oil savers offered to the Oil Industry. The varied types include GUIBERSON High-Pressure and Standard Tubing and Drill Pipe Oil Savers, the GUIBERSON Tubing Stripper, the GUIBERSON Wire Line Oil Saver and the GUIBERSON Sucker Rod Stripper.

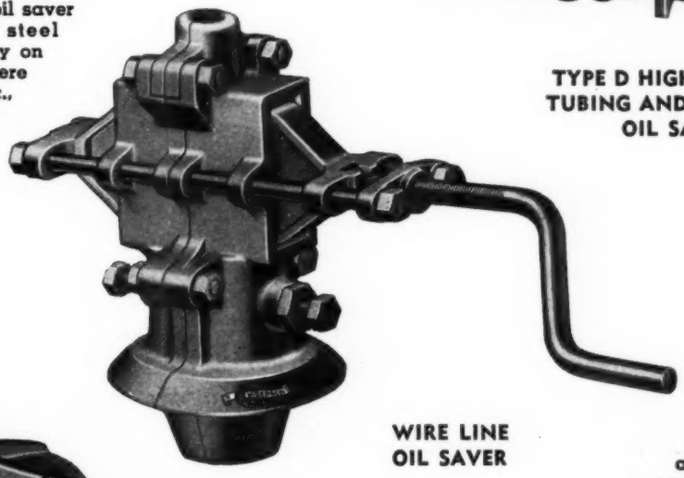
GUIBERSON High-Pressure Oil Savers, especially Types "C2" and "D", are constructed for working tubing under high pressures and for use in conjunction with drilling of oil formation under pressure. All GUIBERSON oil savers have rubbers which are of oil-resisting compound, allowing passage of both tubing and drill collars with no leakage, yet having long life, and are of patented construction.

TYPE D HIGH-PRESSURE TUBING AND DRILL PIPE OIL SAVER

The GUIBERSON Type "B" Tubing Oil Saver is primarily a tubing oil saver constructed with split type steel housing, facilitating assembly on well. It is recommended where tubing catchers, packers, etc., are run where pressures do not warrant use of Type "C2" or Type "D". Shop-tested for 800 lbs. hydrostatic pressure.

The GUIBERSON "C2" Tubing and Drill Pipe Oil Saver, here shown, is primarily used for drilling in under pressure. It is of one-piece, all-steel construction. Tested for 1200 lbs. hydrostatic pressure.

The GUIBERSON Type "D" Tubing and Drill Pipe Oil Saver, here shown, has recently been added to the line and is used both for working tubing and drilling in under pressure. It is of one-piece, all-steel housing. Tested for 3000 lbs. hydrostatic pressure.



WIRE LINE OIL SAVER

The GUIBERSON Wire Line Oil Saver, here shown, has introduced an improved patented method of operating the main packing rubbers. One crank adjusts both rubbers simultaneously, giving equal pressure automatically. Tested for 500 lbs. hydrostatic pressure.

SUCKER ROD STRIPPER

The GUIBERSON Sucker Rod Stripper, here shown, is a recent tool designed to strip oil and paraffin from rods and couplings in coming out and prevents oil leakage when rods are being pulled or run. Tested for 500 lbs. hydrostatic pressure.

All GUIBERSON oil savers can be supplied with regular or special adapters. For full details on oil savers or other GUIBERSON specialties, see your supply house, ask us for special bulletins, or consult the Composite Catalog, starting page 547.

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THE GUIBERSON CORPORATION

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Mid-Continent Supply Company lines* were selected

* *Principal Mid-Continent Distributed Products:*
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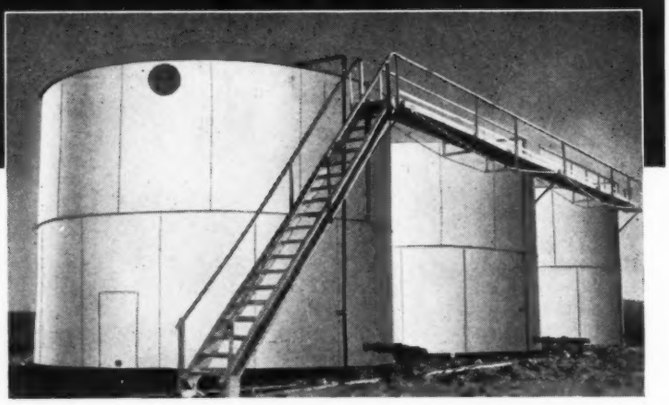
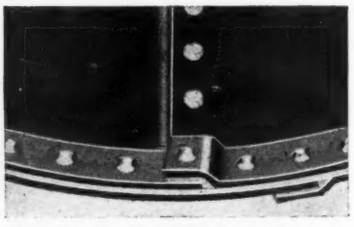
7 pounds of pure zinc spelter to 100 pounds of steel



Maloney Galvanized Tanks and Maloney Cantilever-Type Stairway and Walkway.

There are all grades of galvanized coatings. When MALONEY decided to offer galvanized tanks it was a foregone conclusion that only the *best* galvanized coating obtainable would be good enough for MALONEY Tanks.

"Double Hot Dipped" AFTER Fabrication. MALONEY applies to standard MALONEY Bolted Steel Tanks of Keystone Copper Steel—an extra-heavy galvanized coating by the "double hot dip" process, *after* fabrication. Steel sheets and parts are first given prolonged treatment in muriatic bath to assure extra-tight bond between steel and zinc. Virgin zinc 99.9% pure is then applied by giving the steel two separate hot dips in the zinc vats. The coating which results, by actual scale weight, weighs more than 7 lbs. per 100 lbs. of steel. The value of the double dip can be judged when it is stated that a single hot-dip coating by our methods withstands the severe Preece Test of 6 one-minute dips in copper sulphate solution.



Maloney Patented Off-set "Crimp"

Application of the coating *after* fabrication insures that all edges, including bolt holes, are coated—and avoids all danger of damaging the coating during fabrication. Our special bolts of 90,000 lbs. tensile strength are also hot-dip galvanized, after which nut threads are re-tapped.

MALONEY Galvanized Tanks offer all MALONEY features, including our cloth-inserted packing of live red rubber, our heavy 2x2 steel deck rafter, attachable to segmental deck sections, our large 30″x 48″ clean-out plate, our non-spark aluminum vacuum-pressure valve and thief hatch.

The famous MALONEY patented "crimp" at seams and joints insures strictly accurate fit of all parts, without calking, and by providing a corrugation increases rigidity and strength of the tank.

MALONEY sectional cantilever-type steel stairways and walkways may also be ordered with our double-dip galvanized coating.

Non-Skid Stairway-Walkway Tread

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Review of Petroleum Development In East Central Texas

WOODBINE BASIN FIELDS

Woodbine Basin Production. Outside of the gigantic East Texas field, the Tyler Woodbine basin has produced 94,071,628 bbl. of oil from five fields with 620 producing wells. Crude oil gravities range from 27 to 41.5 deg. A.P.I. and the thickness of saturated sand from 12 ft., as at Long Lake in Anderson County, to as great as 105 ft., as in the Van field of southeastern Van Zandt County. Depths of production range from 3646 ft. as in the Boggy Creek field in Anderson and Cherokee counties to 5244 ft. in the Long Lake field.

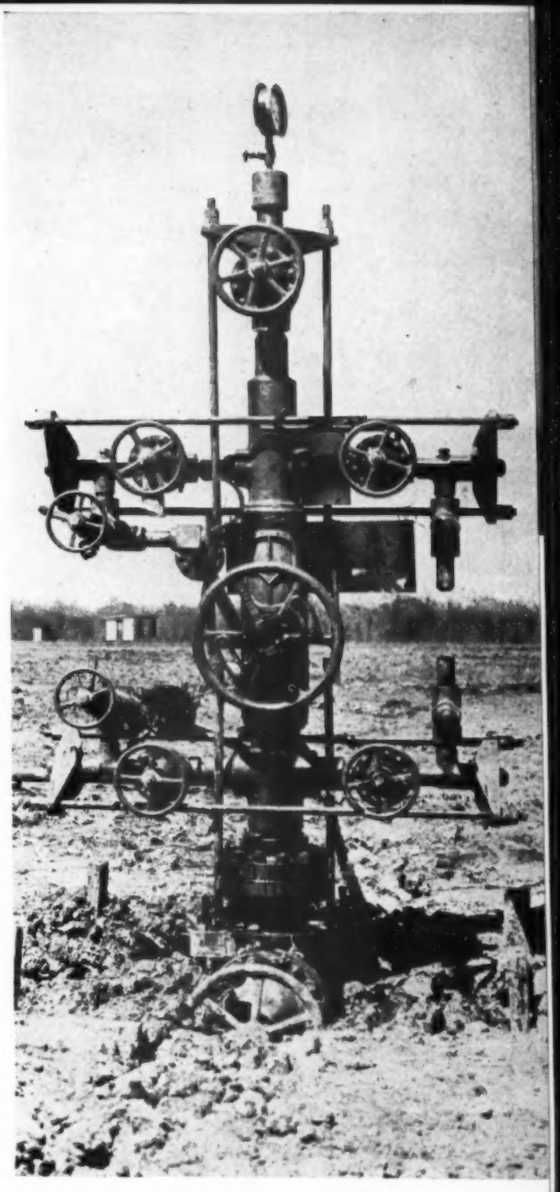
Including gas-producing areas, eight productive domes have been discovered and developed in six counties—Anderson, Cherokee, Freestone, Leon, Van Zandt, and Henderson. Two of the domes are cut by important faults and the accumulation greatly affected by this structural auxiliary condition; these are the piercement-type Boggy Creek salt dome and the Van dome in Van Zandt County. In addition to Woodbine production, Nacatoch production has been obtained on the north flank of the Van structure; Sub-Clarksville production has been developed from eight oil wells in the Camp Hill field of southern Anderson County; and Trinity gas production has been found in the Cayuga field of northwestern Anderson County. The largest field of these structural domes in the Tyler basin, outside of East Texas proper, is the Van field, which has an ultimate recovery conservatively estimated at 250,000,000 barrels. Already this dome has produced 87,520,000 bbl. of crude oil from 475 wells in a proven area of 4390 acres.

Mt. Calm Area. Another Woodbine province is that in Hill County near Mt. Calm where two oil wells have been completed since June 21, 1929, from a shallow depth of only 688 feet. The gravity of the oil is 31.5 deg. A.P.I. The development is commercially unimportant but interesting from a regional standpoint. It is definitely outside of the Tyler basin proper.

Boggy Creek. Although the Woodbine sand production in Texas dates back to 1922 at Mexia, still the discovery of production in the Woodbine salt dome basin did not begin until 1927 when flush production was found at Boggy Creek on the Carey Lake salt dome in Cherokee County. The discovery well was the Humble Oil and Refining Company's and Rio Bravo Oil Company's No. 1-A Earl and Ragsdale in the N. Johnson Survey that came in making 10,000 bbl. of oil per day from the upper Woodbine through a small choke at a total depth of 2950 feet. During the next two years, 13 oil wells were completed on the southeast flank of the dome in both Cherokee and Anderson counties. To date the pool has produced slightly in excess of 3,000,000 barrels. Production is obtained at the intersection of a fault, trending northeast to southwest, and the Carey Lake shallow piercement-type salt dome. Carey Lake is the only piercement-type salt dome that has proven productive to date in the Woodbine basin. During the following four years 46 tests drilled on 12 interior shallow domes have proved failures; the domes tested were Tyler, Bullard, Whitehouse in Smith County, Hawkinsville in Wood County, Grand Prairie in Van Zandt County, Bethel, Keechi, and Brushy Creek in Anderson County.

Van. Van, in southeastern Van Zandt County, is one of the group of so-called ideal oil fields of the world. The field was discovered October 14, 1929, by the Pure Oil Company. Acreage was unitized and development continued with the Pure as the operating company. Production is from the Woodbine at 2900 ft., indicating more than 3000 ft. of uplift. The structure, which first made itself evident by an irregularity in the dip in the lower Claiborne formations at the surface, was checked with the core drill and the reflection seismograph. To date more than 87,520,000 bbl. of oil has been taken from this reservoir, from 475 wells in a proven area of 4390 acres.

The geologic structure is regarded as a deep-seated salt dome, although no dome material has been found in any of the tests drilled to date, some of which have reached into the Paluxy phase of the Trinity formation. The structure is interrupted by a local fault across the crest with the upthrow side to the southeast, the axis trending northeast to southwest. Production also has been obtained from the Nacatoch sand at 1100 ft. from more than 15 oil wells on the north side of the field where pay sand is found from 1100 ft. to 1200 ft. yielding 20-bbl. to 30-bbl. producers.



Christmas tree installation in the Cayuga field of Northwestern Anderson County. Production is found at 4100 feet

Buffalo. The southern producing limits of the Woodbine interior basin was extended 22 miles southward on October 24, 1933, when high-pressure gas production was encountered on the Buffalo structure in central Leon County. The discovery well was the Shell Petroleum Corporation's No. 1 Mrs. Alice Beggs fee in the John Carter survey. Initial production was 17,000,000 cu. ft. of gas per day through chokes on 2½-in. tubing from a total depth of 5723 ft., at a penetration of 105 ft. in the Woodbine formation.

The structure was found after it was checked with geophysical instruments by the Shell Petroleum Corporation. Eight companies participate in

the project as follows: Penn Oil Company, one-eighth; Darby Petroleum Company, one-eighth; Humble Oil and Refining Company, one-sixteenth; Black, one-sixteenth; Frank Buttram, one-sixteenth; Westland Oil Company, one thirty-second; and Gardner Petroleum Company, one thirty-second. It was originally revealed in 1930 through core-drill exploration arranged by the late R. R. Penn, and J. R. Black.

Long Lake. One of the deepest productive oil and gas fields in the Woodbine formation in the East Texas basin was opened southwest of Palestine in southwestern Palestine County October 14, 1933, on a Georgetown "high" made known by reflection seismograph. The discovery oil well was the Tide Water Oil Company and Seaboard Oil Company's J. O. and Hugo Monnig No. 1 in the Simon Sanchez survey No. 11, 4200 ft. due west of the west bank of the Trinity River. Initial production was 74 bbl. of crude per hour through various-sized tubing and casing chokes, showing 550 lb. tubing pressure and 1450 lb. casing pressure, accompanied by a gas volume of 11,000,000 cu. ft. per day. The gravity of the oil was 39 to 40 deg. A.P.I. Pay sand was found from 5240 ft. to 5248 ft., and the Woodbine from 5147 ft. to 5468 feet. The discovery well was on a 23,000-acre block assembled by the joint discoverers after two small gas wells completed in the Carrizo sand previous to 1920 pointed the way.

In 1935, the field was extended into Leon County to the southwest. The following year, a two-mile west extension carried production into Freestone County, marking the third commercial production for the latter county.

Cayuga. The Cayuga oil field of northwestern Anderson County was discovered northwest of the town of Palestine in March, 1934, through use of the reflection seismograph surveys of the structure of the Georgetown lime. The discovery well was brought in by the Tide Water Oil Company and the Texas Seaboard Oil Company. To date it has produced more than 500,000 bbl. of 27-gravity oil from 320 productive acres. In 1935, the North Cayuga field was opened, extending into Henderson County and adding that county to the productive list. Late in the year gas production was found in the Trinity formation at the Tide Water Oil Company and Texas Seaboard Oil Company's No. A-21 Mrs. N. N. Wills in the Samuel Edmondson survey in the heart of the field. It produced through casing perforations for an initial output of 74 bbl. of 55.8-gravity distillate with 5,800,000 cu. ft. of gas through tubing from a plugged-back depth of 7416 ft., although the original total depth was 9085 feet. The well built up a shut-in pressure of 3150 pounds. Its discovery was the second oil field found in Anderson County in seven months using the same method of geophysical exploration by the same company that discovered Long Lake in the southwestern portion of the county.

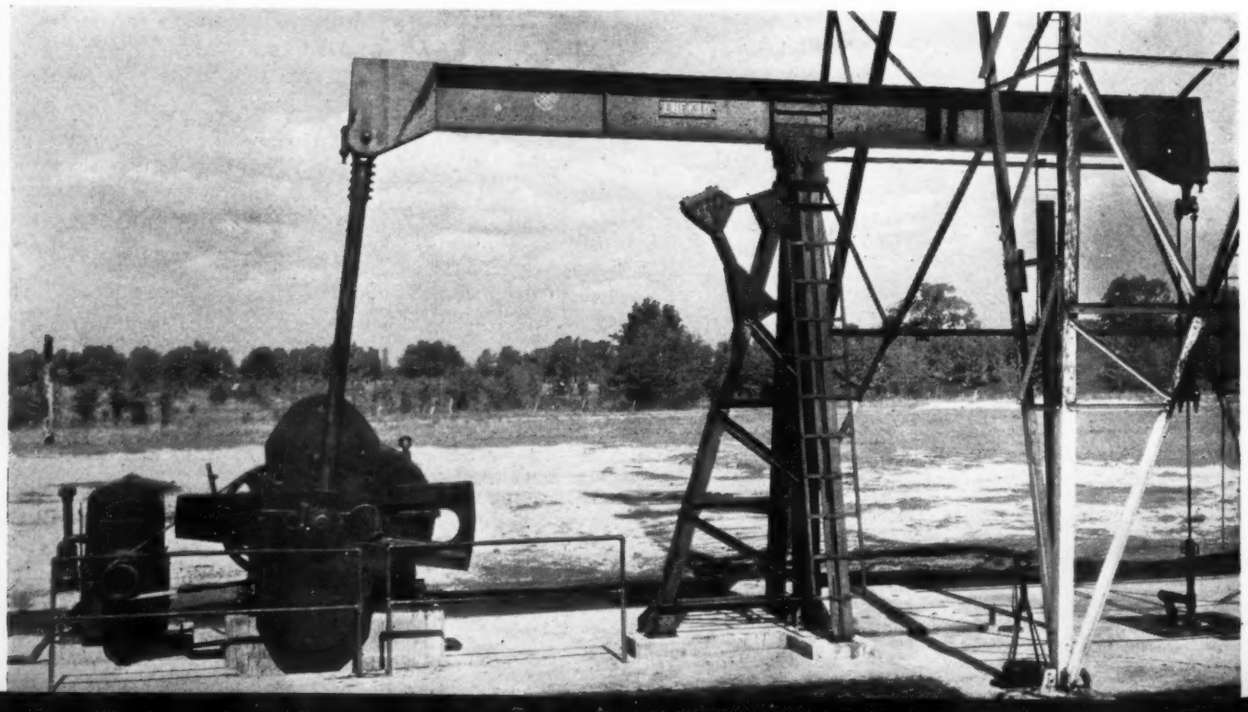
Red Lake. Five months after the discovery of Cayuga, another Woodbine field was opened in southeastern Freestone County, southeast of Fairfield, the first production for that county since the Wortham field was extended into it more than 12 years before. The discovery well, in the Aguilares survey, made an initial production of 5,000,000 cu. ft. of gas per day. A second gas well was completed in the Woodbine the following year. The structure is on a regional minima on torsion-balance evidence, being parallel to the Van-Cayuga fault trend.

Rusk. One of the most spirited leasing campaigns in the Woodbine basin since the discovery of the East Texas field followed the discovery of commercial production in the Rusk fault area, southwest of Rusk on June 14, 1934. T. J. Young et al's No. 1 New Birmingham Development Company was brought in successfully from the Woodbine sand flowing 48 bbl. of 41-gravity oil per hour through 3/16-in. choke in a sidetracked hole. It is on a tract farmed out from Shell Petroleum Corporation. The producing horizon was found from 5175-79 feet. By June 1, 1936, the field had produced 144,690 bbl. of oil from three wells.

New Birmingham Development Company realized from its holdings after the iron ore project of that company had failed more than three decades previous. More than $200,000 of acreage was sold by this once-defunct company in oil and gas leases. The East Texas Baptist Institute, which opened up in 1894 and was closed in 1928 because of financial difficulties 34 years later, sold an oil and gas lease on the old campus for a consideration of $35,000 in cash and assumption of indebtedness by the Lion Oil Refining Company of Eldorado, Arkansas.

Camp Hill. The fourth oil field

Typical pumping installation in the Cayuga oil field, at Stanolind Oil and Gas Company's No. 1 W. L. Tubbs. Production is from the Woodbine formation



for Anderson County was opened in February, 1935, by the Gulf Production Company with their No. 1 M. Davey and Tucker Royall in the M. Rogers survey, nine miles southeast of Palestine. It was completed in the sub-Clarksville phase of the Eagleford shale, opening a new productive formation for the state. Later production was found in the Woodbine sand proper by the Gulf and the Sun companies. Gulf laid a pipe line to their pumping station at Elkhart to run the crude from the field.

First commercial production from the sub-Clarksville phase of the Eagleford of upper Cretaceous was opened January 26, 1935. The discovery oil well came into production from the first plug-back level of 5081 ft., flowing an ungauged volume of gas and a spray of salt water through a 7/16-in. choke under a flowing pressure at the casing of 800 lb., and registering a closed-in pressure of 1200 lb. on a later test. The 7-in. casing was landed at 5027 feet. Later the casing pressure increased to 1900 lb. and to shut off water encroachment the operators plugged back to 5059 feet.

The discovery marked the fourth field for the county and is seven miles southeast of Palestine and eight miles due north of the village of Slocum. It is 130 miles north of Houston. The well was originally drilled to a total depth of 5969 ft. in the Georgetown lime, topped at 5948 feet. The Woodbine formation, found from 5176 ft. to 5948 ft., proved unproductive on drill stem and core tests. The Pecan Gap chalk was penetrated from 3891 ft. to 4222 ft. and the Austin chalk at 4879 feet. The surface elevation is 572 ft., and the producing zone is the sub-Clarksville, above the Woodbine.

BALCONES FAULT ZONE PRODUCTION

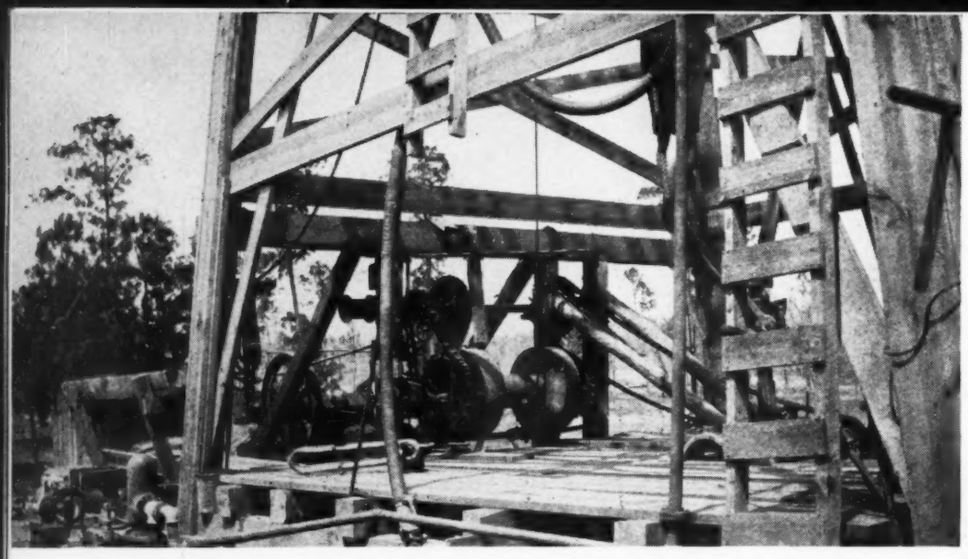
Edwards Lime Production

The Edwards lime of Lower Cretaceous age has been productive in four counties along the course of the Balcones Fault zone as follows: Caldwell, Frio, Guadalupe, and Lee. To January 1, 1934, a grand total of 119,783,000 bbl. of oil had been produced from this prolific formation. Of this total, three fields have produced 119,600,000 bbl. since 1923. Normal recovery per acre for Edwards lime production varies from 15,000 bbl. to 40,000 barrels. Producing depths range from as shallow as 1309 ft. in the Larremore field of Caldwell County to as deep as 2688 ft. in the Salt Flats field of the same county. The oil varies in

SUMMARY OF PRODUCTION IN WOODBINE BASIN, EAST TEXAS REGION[1]
TYLER SALT DOME BASIN

County	Field	Location	Type Structure	Date of Discovery	Productive Acres		Cumulative	Ultimate Recovery	Total Wells		Pay Sand Data		Gravity of Oil Deg. A.P.I.	Principal Operators
					Oil	Gas			Oil	Gas	Av. Depth—Ft.	Thickness of Saturated Sand		
Anderson	Camp Hill	S. E. Palestine	Structural Dome	Jan. 26, 1934	400				11		5106			Gulf, Sun
Anderson-Henderson	Cayuga	N. W. Palestine	Structural Dome	March, 1934	7,100		1,903,000[2]		90	6		30 ft.	27°	Tidewater, Seaboard
Anderson	Long Lake	S. W. Palestine	Structural Dome	Oct. 14, 1933	14,000		218,000[2]		17	4	5244	12 ft.		Tidewater, Seaboard
Anderson-Cherokee	Boggy Creek	E. Palestine	Faulted Salt Dome	Mar. 3, 1927			4,315,000		23		3046	34 ft.	38.2°	Humble, Rio Bravo
Cherokee	Rusk	S. W. Rusk	Fault	June, 6, 1934			115,628		4				41.5°	T. J. Young, Shell
Freestone	Red Lake	S. E. Fairfield	Structural Dome	May 20, 1934		2								Shell
Leon	Centerville	N. Centerville	Structural Dome	March, 1933	30	2					5723			
Van Zandt	Van	W. Tyler	Faulted Dome	Oct. 14, 1929	4,390		87,520,000	250,000,000	475		2756	105 ft.	35-36	Pure Oil Company
Hill	Mt. Calm	E. Mt. Calm		June 21, 1929					2		688	8 ft.	31.5°	J. A. Harper
Rusk, Smith, Upshur, Gregg Cherokee	East Texas	W. Henderson	Eroded Shoreline	Sept. 6, 1930			835,000,000	4,600,000,000			3660	38 ft.	39.6°	Stanolind, Mid-Kansas, Humble, Texas, Shell, Magnolia
MEXIA FAULT ZONE DISTRICT														
Freestone-Limestone	Wortham		Fault	Nov. 22, 1924	715		22,415,000		322		3028	35 ft.		
Limestone	Cedar Creek		Fault	Aug. 8, 1927	25		297,945		7					
Limestone	Mexia		Fault	Nov. 5, 1920	3,720		93,910,000		552		2961	40 ft.	35.7	Humphreys, Humble
Limestone	Nigger Creek		Fault	July 8, 1926	170		2,985,793		29					
Navarro	Corsicana-Powell		Fault	Jan. 7, 1923	2,650		114,125,000	150,000,000	321		3042	45 ft.		
Navarro	Currie		Fault	Dec., 1923	375		6,326,427		29		2970		41.5°	
Navarro	Richland		Fault	Oct., 1921	240		6,561,997		17					

[1]To January 1, 1936. [2]To March 27, 1936.



For development in the Serpentine, Edwards lime and Austin chalk shallow production to depths of 3000 ft., a light-weight rig such as shown here is typical of East Central Texas drilling operations

gravity from 27.5 deg. to as high as 36.5 deg. A.P.I., oil of the latter gravity being found in the Salt Flats field. The water line in the producing field generally parallels the structural contour of the Edwards lime, hence operators always have completed at a certain structural contour to prevent premature water encroachment. Production in almost all cases is obtained on local faulted structures, the upthrow side generally being situated on the southeast side of the displacement.

Luling. The first large field in the Edwards lime was opened August 8, 1922, near the town of Luling in southern Caldwell County (east of San Antonio) by Edgar B. Davis, head of the United North and South Development Company. It marked the first sizeable production from fault-line fields situated along the southern portion of the Balcones Fault zone. At the time, Magnolia Petroleum Company came to the aid of Davis in his development following the discovery, offered him a loan and contracted to purchase his oil. Two years later, after the property was well beyond its first stages of development the Magnolia purchased the Davis properties for $12,100,000. At the time, it was the largest outright purchase of oil-producing properties ever consummated in the State of Texas. This fact is all the more remarkable since Davis "poor-boyed" his well, offering acreage to his crew in return for labor. The pool-opener was No. 1 Rios, completed at a total depth of only 2235 ft. for an initial production of 150 bbl. of 28-gravity oil per day.

The Luling field subsequently proved to be eight miles in length; however, because of its fault position and arrangement, its width did not exceed 3400 feet. By January 1, 1934, a grand total of 59,094,580 bbl. of oil had been produced from 592 oil wells, in addition to the completion of two gas wells. The principal leaseholder in this field is the Magnolia.

Salt Flats (Bruner). The next Edwards lime pool discovery of any importance was made in April, 1927, in the same county as Luling. The discoverers were Sullivan and Associates, who completed their No. 1 Bruner at 2688-2722 feet. Like Luling, production was found along the southeast upthrow side of a local fault displacement. By January 1, 1934, 30,500,000 bbl. of oil had been produced from a total of 335 wells on 1050 acres proven production. In this field, the main leaseholders are the Humble Oil and Refining Company, The Texas Company, the Magnolia Petroleum Company, the Sun Oil Company, and the Shell Petroleum Corporation.

Darst Creek. Two years later, the third of the series of large Edwards lime fields was opened, this time in Guadalupe County. The discovery well was brought in during July, 1929, by The Texas Company with their No. 1 Dallas Wilson, drilled to a total depth of 2610 ft., five ft. in the Edwards. Its initial production was 100 bbl. of 36.3-gravity oil per hour. More than 30,000,000 bbl. of oil had been produced by January 1, 1934, with 286 wells and 1700 acres proven productive. Like its illustrious predecessors, Luling and Salt Flats, this field also was productive from a narrow strip on the upthrow side of a local fault.

A record production performance for Edwards lime wells was that of the Gulf Production Company's No. 1 Christopher Knoblock in the Joel R. Robinson survey in the Darst Creek field. It blew in during March of 1930, flowing at the rate of 9000 bbl. per day. Three days previously, the same company had completed for 300 bbl. per day its No. 2 Thomas Dix in the Robinson survey.

Doering. A new producing region was opened in Texas in southwestern Frio County on April 4, 1934, by the completion of a crevice gas producer from Del Rio, Buda, and Georgetown lime breaks, the origin of the oil from which is undoubtedly the Edwards lime. It was Amerada Petroleum Corporation's No. 1 F. Doering, which showed an initial production of 1,400,000 cu. ft. of gas from a depth of 6459 ft. in a sidetracked hole. It is situated on the southeast upthrow side of a major fault that trends northeast southwest, similarly located to Luling, Darst Creek, and Salt Flats.

Larremore. Another fault structure, but smaller in productive area, was opened near Lockhart in Caldwell County, known as the Larremore pool. The discovery well was the Roxana Petroleum Company's (Shell Petroleum Corporation) No. 1 A. W. Jolly, completed June 26, 1928, from the exceedingly shallow depth of 1351 ft. in the Edwards. To date 12 oil wells have been placed on production and 50 acres proven productive.

Summary. To date, 1230 oil wells have been completed in seven fields in four counties, proving 4980 acres productive of oil. Although production has been obtained from not deeper than 2712 ft., it is probable that additional reserves will be developed in the Edwards lime at various depths down to 6500 ft. along regional fault zones paralleling the Balcones fault, similar to that already proven at Doering in Frio County, productive at 6459 feet. The area between Frio County and Burleson County will be due for important prospecting.

SERPENTINE PRODUCTION

Locale. Production from serpentine, or altered igneous material, has been developed since February, 1914, in five counties along the Balcones-Mexia fault zones. It has been obtained from 15 fields, on the crests and flanks of these serpentine plugs intruded into the Taylor formation just above the Austin chalk of Upper Cretaceous age. These fields are situated between Lockhart and Bastrop and between Austin and Rockdale along regional lines of weakness trending northeast to southwest.

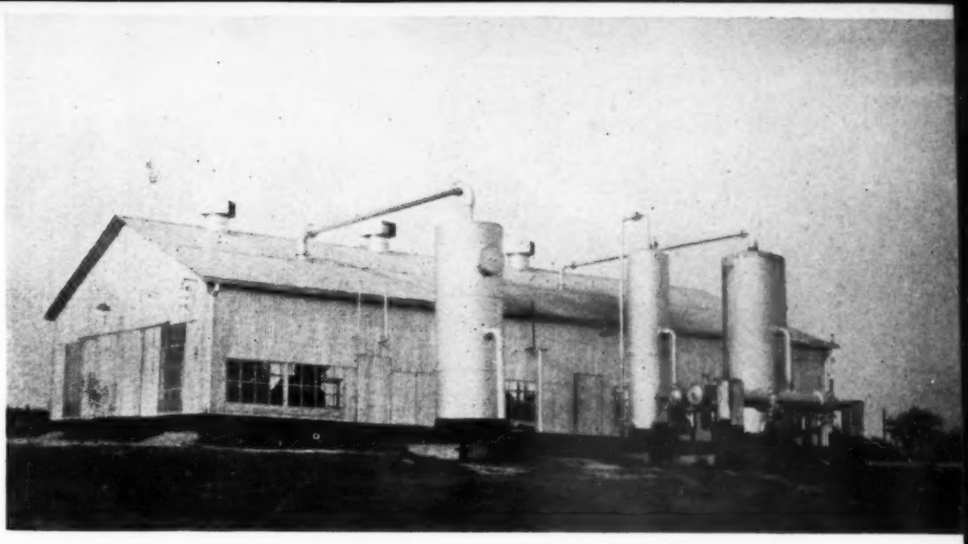
Production. A cumulative production of 15,700,400 bbl. of oil had been recorded to January 1, 1934, from 656 oil wells in these 15 fields. The highest initial production was recorded in the Hilbig field of Bastrop County. Humble Oil and Refining Company's No. 1 Annie Hassler in the Samuel Wolfenbarger survey, approximately seven miles southwest of the town of Bastrop, flowed 57 bbl. of oil

the first hour and 78 bbl. per hour thereafter from serpentine found at 2468-2577 feet. Gravities range from 29.5 deg. to as high as 38.0 deg. A.P.I. Recoveries as high as 5000 bbl. per acre have been obtained in Lytton Springs, which has produced the greatest cumulative total out of all serpentine fields in East Central Texas. Production depths range from as shallow as 664 ft., in the Kimbro oil field of northern Travis County, to as deep as 2200 ft., as in the Dale field of Caldwell County. From the standpoint of areal productive extent, these fields average 215 acres, although one field, Lytton Springs, has a productive area of 1360 acres. Other of the comparatively larger serpentine fields are Chapman in Williamson County, with 350 productive acres; Thrall in Williamson County, with more than 475 productive acres, and North Dale in Bastrop County with more than 250 productive acres.

Geology and Exploration. Serpentine intrusions are associated with major faults in the Balcones fault system and represent peaks of weakness along regional fault displacements, occurrences predominating on the upthrow side of local faults. The magnetometer has been singularly successful in outlining and defining many of the larger serpentine plugs. Not all serpentine plugs are oil-productive from the serpentine formation itself, although local uplift caused by the serpentine plug intrusion may be responsible for oil accumulation in overlying formations; for example, the Chicon Lake field of southeastern Medina County.

Almost 800,000 bbl. of oil had been recovered by the first of 1934. Prominent in the development of this field were the Atlantic Oil Producing Company and the Gulf Production Company. The field is 98 acres in extent and has 26 oil wells.

Chapman. The second largest serpentine oil field developed to date is the Chapman field of Williamson County, discovered in January, 1930. More than 3,600,000 bbl. of oil was produced in the three-year period following the discovery. The field is 350 acres in extent and has 128 wells. The field was named after E. L. Chapman, its discoverer. Production is found at a depth of 1786 ft., producing a 37.2-gravity crude, one of the highest gravity crudes obtained from serpentine plugs in the region.



Repressuring plant of the Humble Oil and Refining Company in the Hilbig field, Bastrop County. This plant, the only one in East Central Texas, repressures 13 wells

Hilbig. One of the most spectacular serpentine discoveries was the Hilbig field, brought in February, 1933, by the Humble Oil and Refining Company, seven miles southwest of the town of Bastrop. The discovery well, No. 1 Annie Hassler, in the Samuel Wolfenberger survey, flowed 57 bbl. of oil the first hour from 2468-2577 ft. in the serpentine pay. The second hour it flowed 78 bbl. an hour, after which the well was choked down with a 3/64-in. choke.

Humble has completed 14 wells on this dome, proving up 200 acres. A repressuring plant was installed in 1934 and all the Humble wells on the plug are reported as flowing.

Thrall. The first important serpentine oil field, developed in East Central Texas, was discovered February 22, 1915, near the town of Thrall in Williamson County after surface indications pointed the way. A producing sand was found at approximately 900 ft., marking the most shallow serpentine field yet developed. The initial production of the discovery well was 50 barrels. To date 190 completed oil wells have proven 480 acres to be productive. The cumulative recovery to the end of 1933 was 2,300,000 barrels. The Magnolia Petroleum Company is the leading operator in the field.

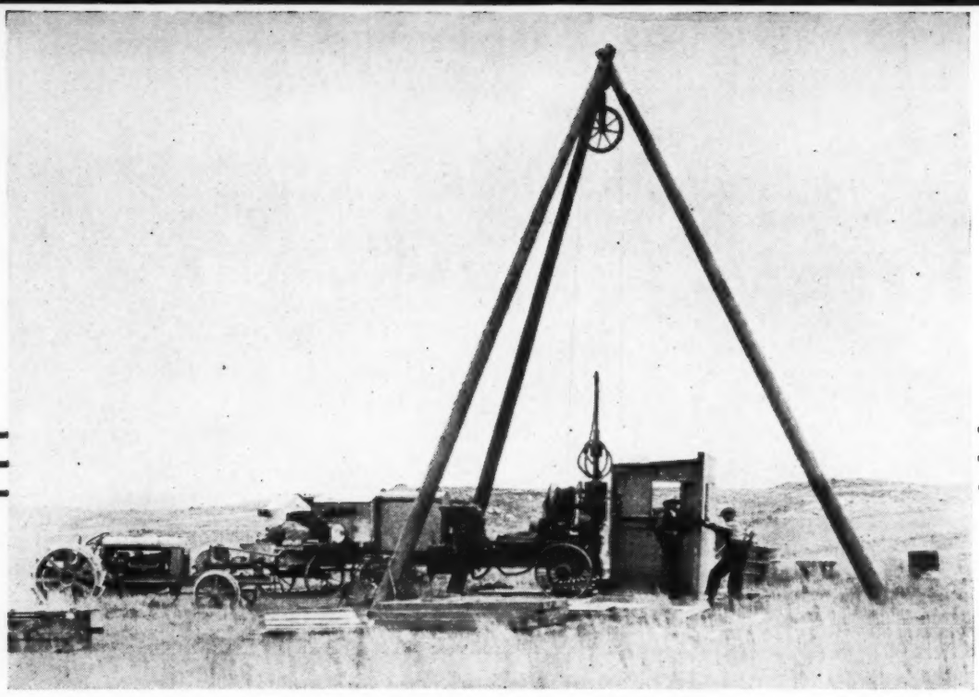
Lytton Springs. The next serpentine discovery of any importance was in March, 1925, near the town of Lytton Springs in Caldwell County. Lefevre and Storey's No. 1 Mrs. M. L. Brewer was completed at a total depth of 1252 ft. for an initial output of 75 bbl. of oil per day. It comprises the largest productive serpentine plug both as to cumulative recovery and productive acreage. By the early part of 1934 the field had produced 7,580,000 bbl. of oil from 288 wells, which proved 1360 acres to be pro-

PRODUCTION SUMMARY*

EDWARDS LIME POOLS

County	Field	Date of Discovery	Productive Depth	Productive Acres	No. Oil Wells	Gravity of Oil	Cumulative Production[1] (Barrels)
Caldwell	Buchanan	June, 1930	2246 ft.	10	1	.....	.....
Caldwell	Larremore	Dec. 1928	1309-1351 ft.	50	12	23.5	183,000
Caldwell	Luling	Aug. 8, 1922	2100-2175 ft.	2130	594	27.5–29.0	59,100,050
Caldwell	Salt Flats	April, 1927	2688-2712 ft.	1050	335	36.5	30,500,000
Frio	Doering	April 4, 1934	6459 ft.	20	1[2]	35.4	.....
Guadalupe	Darst Creek	July, 1929	2610 ft.	1700	286	35.0	30,000,000
Lee	Batey	1934	.....	20	2	.....	.....
*Summary—Four counties, seven fields, from 1309 ft. to 2712 ft.; 4980 acres; 1230 oil wells.							119,783,050

[1]To January 1, 1934.
[2]1,400,000 cu. ft. of gas per day, gas well only.



The core drill is one of the most effective methods used in modern-day exploration for oil-bearing structures

ductive. Participating in the development were Magnolia Petroleum Company, Gulf Production Company, The Texas Company, Sun Oil Company, and the Mid-Kansas Oil and Gas Company (now the Marathon Oil Company).

Dale. A new productive horizon was opened in the region in 1927 when a conglomerate of chalk and serpentine, locally known as the Dale lime, was brought into production with the discovery of the Dale plug in Caldwell County, southeast of the town of Dale. The discovery well was The Texas Company's No. 1 Beatty, producing from 2324 feet. Almost 1,000,000 bbl. of oil had been produced by the end of 1933. Forty oil wells have been drilled and 180 acres proven productive. This structure is characterized by faulting, and production is found on the upthrow side.

Yost. The following year another important serpentine discovery was made at Yost in southern Bastrop County. Cranfill and Reynolds completed their No. 1 A. M. Yost at a total depth of 1600 feet. The discovery well made 400 bbl. of 25.2-gravity oil per day.

AUSTIN CHALK PRODUCTION

Commercial possibilities of the Austin chalk were not realized until January of 1936 when a 3000-ft. producer was completed in the new Pearsall-Smith field of southwestern Frio County. One of the producers there made 1316 bbl. of oil in one hour and 20 minutes through open tubing and casing.

Although only 600,000 bbl. of oil has been obtained to date from 21 wells covering 145 acres in 13 productive areas in four counties, it is believed that, with the exception of Pearsall, the major development of Austin chalk production has not yet been touched. Pearsall production is found in the chalk at depths of 5272-5492 ft., and definitely proves that additional reserves lie down-dip from the old Balcones Fault zone in Atascosa, Wilson, Gonzales, Burleson, Lee, and Zavalla counties.

PRODUCTION SUMMARY OF SERPENTINE OIL FIELDS

Situated in Bastrop, Caldwell, Guadalupe, Travis, and Williamson Counties

County	Field	Date of Discovery	Depth of Pay Sand	No. of Oil Wells	Acres Productive	Gravity of Oil	Cumulative Production[1]	Average Initial	Present Production
Bastrop	North Dale	Sept. 1932	2160	14	250	37.1	213,783		
Bastrop	Hilbig	Feb., 1933	2470	14	200	38.0	87,286		
Bastrop	N. Cedar Creek	Aug., 1934	1628	2	20	34.8	.....		
Bastrop	S. Cedar Creek	May, 1933	1690	14	90	34.2	11,273	400	33
Bastrop	Schimmel-Batts	July, 1931	1460	3	30	31.0	1,500		15
Bastrop	Yost	Nov., 1928	1465	25	97	31.0	795,051		110
Caldwell	Buchanan	April, 1930	2050	5	125	38.1	134,815		.....
Caldwell	Dale	Aug., 1927	2200	36	175	37.5	900,920		250
Caldwell	Lytton Spr	Mar., 1925	1550	202	1360	37.5	7,579,864		450
Caldwell	Lytton Twns	Nov., 1928	1505	2	5	29.5	.....		.....
Guadalupe	Medlin	Feb., 1930	2062	1	10		.....	25	
Travis	Kimbro	Oct., 1934	664	2	15	....	.....		195
Williamson	Byersville	Oct., 1933	904	18	50	37.2-39.	500	60	75
Williamson	Chapman	Jan., 1930	1786	128	350	37.2	3,638,387		600
Williamson	Thrall	Feb., 1914	900	190	480	37.5	2,308,221		35
Averages and Totals of five counties and 15 fields			1602	655	3247	35.5	15,700,400	90	1720

[1]To Jan. 1, 1934.

To date the counties where production is found in the chalk are Bexar, Caldwell, Frio, and Guadalupe. Production depths range from as shallow as 700 ft., as in the Staples field of Guadalupe, to as deep as 5492 ft., as in the Pearsall field of Frio County. Gravity of the crude ranges from 28 deg. to 37.3 deg. A.P.I. Average initial production will vary from 60 bbl. to 850 bbl. per day, with the exception of the gusher production in Frio County.

As the result of the Pearsall development, Austin chalk tests have been started in Atascosa and Zavalla counties. The production developed heretofore on the Balcones fault zone has largely been crevice production in Bexar, Caldwell, and Guadalupe counties, but with the development of deeper reserves along auxiliary fault zones parallel to the Balcones fault, long-lived fields produced through back pressure and conservation of the reservoir energy are believed assured, in contrast to the flush, short-lived crevice producers found at shallow depths.

Almost 210,000 bbl. of oil has been produced from the Austin chalk by two wells in the Bob Rose or Dunlap field. Six miles southeast of Seguin in Guadalupe County, W. J. Walton et al's No. 3 Zoboroski swabbed 500 bbl. of oil per day from soft Austin chalk topped at 2178 ft., with saturation found from 2194 to 2199 feet. In the Branyon field, cumulative production of 45,000 bbl. of oil has been obtained from the Austin chalk. In Bexar County years ago, the Witherspoon well had an initial production of 800 bbl. per day. Other Austin chalk production has been found in the Staples field of northwestern Guadalupe County, in the Sal-Mar field, in the Luling field of Caldwell County, and in the Salt Flat field of Caldwell County.

Production possibilities from the Austin chalk down-dip at lower regional positions is revealed by the fact that in Wilson County, Humble Oil and Refining Company's No. 1 B. B. Hardy in the Joseph Reynolds Survey had a gas pressure of 200 lb. from the Austin topped at 4922 feet. This test was drilled in July, 1933.

Crude Oil Analysis—Austin Chalk Oil. A laboratory analysis of Austin chalk crude was run July 13, 1932, of a sample taken from C. J. Webster Oil and Gas Company's No. 1-A McCrory in the Bobrose or Branyon field of Caldwell County, showing the following:

GASOLINE DISTILLATION

Initial Boiling Point	132
10%	205
20%	231
30%	249
40%	268
50%	284
60%	300
70%	321
80%	343
90%	375
End Point	449
Recovery	99.0%
Color	26 plus
Doctor Test	Positive
Gravity	55.9
Sulphur Content	0.533%

Crude Gravity	Gravity 37.0 deg. A.P.I.	Percent
Gasoline at 400 deg.	55.9	27.73
Distillate at 400 to 500 deg.	42.6	11.60
Gas Oil at 500 to 665 deg.	36.2	37.33
Fuel Oil	23.2	22.66
Loss		00.68

Pearsall. By far the most important Austin chalk field is Pearsall in Frio County, south of San Antonio, opened in 1936 by the Amerada Petroleum Corporation and the Rycade Oil Corporation. To date four oil wells have been placed on production from the chalk and two additional Navarro sand wells are in process of being deepened to the chalk at this writing.

Amerada Petroleum Corporation and Rycade Oil Corporation's No. 1 Michael was completed on January 3, 1936, for an initial production of 3086 bbl. of 38-gravity oil in 28 hours, produced through a 1-in. choke from a total depth of 5655 feet.

Amerada-Rycade's No. 5 Halff-Oppenheimer made 850 bbl. of oil per day from a total depth of 5465 ft., after acidizing on March 5, 1936. When originally completed on February 28, 1936, it produced 336 bbl. of oil in 24 hours.

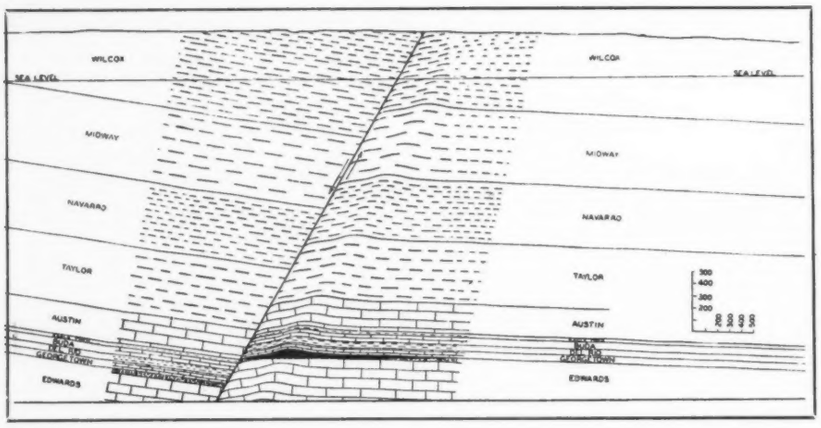
Amerada-Rycade's No. 6 Halff and Oppenheimer was completed March 4, 1936, for an initial production of 1316 bbl. in 80 minutes through open tubing and casing. On proration test through 2½-in. tubing and 1-in. tubing choke it made 208 bbl. per hour.

Amerada-Rycade's No. 1 Cory and McWilliams made 269 bbl. per hour and 8,000,000 cu. ft. of gas per day after treatment with 3000 gal. acid and a 130-qt. shot in the Austin chalk, topped at 5490 ft. and drilled to 5569 feet.

NAVARRO SAND PRODUCTION

Summary. Navarro sand production has been developed in several widely-scattered portions of the Balcones Fault zone in Atascosa, Bexar, Frio, Medina, and Milam counties. Commercial possibilities loom in the

This map shows the oil fields producing from the Serpentine in East Central Texas



Cross section of Salt Flat field, Caldwell County, Texas. Scale in feet

intervening territory in Fayette, Gonzales, Wilson, Lee, Bastrop, and Burleson counties. Gravities range from 19 deg. A.P.I. as in the Taylor-Ina district of Medina County, to as high as 37.6 deg. A.P.I., as in the Minerva-Rockdale district, Milam County. Structural conditions in these fields in most cases are faults trending northeast to southwest, influenced to a great extent by predominant lenticularity. In the Chicon Lake field of Medina County, structure is due to bulging from a non-productive serpentine plug. Producing depths in these fields range from 900 ft. in Bexar County to 3900 ft. in Frio County.

Somerset. The most important oil field in the Navarro sand is the Somerset field of southern Bexar County and northern Atascosa County. Until the early part of 1934, Somerset had produced 9,250,000 bbl. of oil from a productive area of 11,400 acres whose areal extent is seven and one-half miles in length. It is influenced by a group of faults, and the sands in this field are exceedingly lenticular. The field was opened in 1911 and was the first pool of any importance in the district.

Minerva-Rockdale. Next in importance in Navarro production from the angle of cumulative production and areal extent is the Minerva-Rockdale field of Milam County. More than 3,000,000 bbl. of oil had been produced by the end of 1933 in this field, which covers an area of 4510 acres. In all 615 oil wells have been completed along an area seven miles in length and two miles in width. The highest gravity crude produced from the Navarro in the Balcones fault zone and associated zones to date has been found in this field; it is 37.6 deg. A.P.I. Producing sands vary in thickness from 600 ft. to 1750 feet.

Pearsall. Production of gusher proportions to be uncovered in the Navarro sand in the Balcones fault zone was first found in February, 1935, at Pearsall in southern Frio County, south of San Antonio. Amerada Petroleum Corporation and Rycade Oil Corporation, operating jointly, completed the Navarro sand discovery well on February 9, 1935, with their No. 3 Halff and Oppenheimer. The well made an initial production of 270 bbl. of oil per day at a depth of 3916-3936 feet; however, water trouble necessitated plugging back and, after workover, it was recompleted for 140 bbl. of 25-gravity oil per day through a ½-in. choke. The largest of the four Navarro sand oil wells completed by these interests in the Pearsall field was their No. 1 Davies, brought in April 19, 1935, for an initial production of 25 bbl. of oil an hour at 3913-3921 feet. When placed on gas lift, it produced 33 bbl. of oil per hour. Their No. 4 Halff and Oppenheimer, completed May 25, made five bbl. of oil per hour through ¼-in. choke at 3921 ft., plugged-back depth.

DRILLING

Edwards Lime. The approximate cost of an Edwards lime well in Caldwell and Guadalupe counties will vary from $3000 for the shallower depths to $4500 for the 2700-ft. depth. Operators usually set 200 ft. of 10-in. surface casing and a 7-in. production string on top of the Edwards lime. Drilling time will average 30 days, including time of setting the surface string. Most wells are drilled with wooden derricks. Single cylinder lightweight drilling engines are frequently used for this depth.

In the deeper Edwards lime producing and prospective areas, it is customary practice on a 6500-ft. well to set 250 ft. of 10-in. surface pipe and drill a 9½-in. hole to the Edwards lime where a 7-in. production string is set and cemented. For this depth 50 days is required to drill and complete the well. Steel derricks are used throughout with 12 by 12 drilling engines.

PRODUCTION SUMMARY OF AUSTIN CHALK OIL FIELDS

County	Field	Date of Discovery	Depth of Pay Sand	No. of Oil Wells	Acres Productive	Gravity of Oil	Production	
							Average Initial	Cumulative
Guadalupe	Staples	1935	700	2	20		15	.....
Guadalupe	Clark	1935	2385	6	40			
Guadalupe	Zoboroski		2178	2			500	
Caldwell	Luling							
Frio	Pearsall	1936	5272-5492	4		28.0	850	
Guadalupe	Sal-Mar			1				
Caldwell	Branyon					37.0		45,000
Caldwell	Dunlap	1931		6				210,000
Caldwell	Salt Flats	1928					150	
Bexar	Witherspoon						800	
Caldwell	Thomson	1933	2045	1	55		60	
Guadalupe	Manford	1929	2418	3	20	37.3	450	330,900
Gonzales	Ottine	1928	3790	1	10	32.7	.....	11,968
				21	145			607,868

MEXIA FAULT ZONE DISTRICT

Sale of six wells by the Magnolia Petroleum Company in the old Corsicana field of Navarro County, reported in 1935, recalls that the locale was the site of the state's first commercial oil field. Some of the early wells are still pumping a few barrels per day.

It was there that in 1896 the forerunner of the Magnolia Petroleum Company brought in the first commercial well in the state. Indications of petroleum were shown two years previously when a water well, drilled for the City of Corsicana, showed traces of petroleum.

Production was found from 900 ft. to 1000 ft. in the Taylor formation. The shallow depth was an incentive to development and by the end of the year 1450 bbl. of crude had been produced from the area.

Production from the "cradle of Texas oil" jumped by leaps and bounds. The following year the field's production was 65,975 bbl. and for 1898 exceeded 500,000 barrels.

When Captain Lucas brought in his 70,000 bbl. gusher at Spindletop in January, 1901, the Corsicana field already had produced in excess of 2,000,000 bbl. of oil.

This apparently insignificant area at Corsicana has to date produced more than 8,500,000 bbl. of crude from the shallow zones alone.

Here was laid the foundations for the Texas oil industry, the largest producing sector in the whole oil industry.

One of the most prolific and spectacular oil districts of Texas is the Mexia fault zone, 35 miles east of the main Balcones fault zone. Since 1920, when the Mexia field was discovered, a grand total of 246,622,000 bbl. of oil has been produced from seven principal fields situated in Freestone, Limestone, and Navarro counties on faulted structures.

Mexia. The discovery well of the Mexia field was brought in in Limestone County on November 5, 1920, by Col. E. H. Humphreys of the Humphreys Oil Company, who found production in the Woodbine sand of Upper Cretaceous age at a depth of approximately 3000 feet. Gushers were found in the immediate vicinity of the local fault, which proved to be productive for an extent of seven miles in length and 1¼ miles in width. Production was discovered on the upthrow side of the fault, which had from 200 ft. to 400 ft. of vertical displacement, the downthrow side being on the west.

Like the Luling structure in Caldwell County, the Mexia anticline was mapped by competent geologists in advance of drilling. Cumulative production of this field, as of January 1, 1936, was 93,910,000 bbl. from a total of 552 oil wells drilled on 3720 proven acres. Mexia, the largest in areal extent, was exceeded in total daily production by the Corsicana-Powell field, discovered January 7, 1923.

Map showing all the developed oil fields along the course of the Mexia fault zone in Limestone, Freestone and Navarro counties. Relation to the deep-seated and piercement-type salt domes on the East Texas Woodbine basin is shown

Powell. The Corsicana-Powell development began 1¼ miles south of the town of Powell where the Corsicana Deep Wells Company brought in their No. 1 Burk from the Woodbine sand after geological work on the shallow oil-bearing sand of the pool had been mapped by Matson and Hopkins in 1917. This field proved to be faulted for a distance of 7.5 miles, the oil production extending 4000 ft. east of the fault plane. The Powell Woodbine sand development is characterized by the rapidity of the development for only one year after the deep sand discovery, a production of 40,000,000 bbl. being handled by the pipe lines, with a daily peak of 356,000 bbl. per day.

Powell was destined to produce more than 114,000,000 bbl. of oil in the decade following its discovery. Conservative estimates on its ultimate recovery are placed at 150,000,000 barrels. More than 820 oil wells have been completed since the discovery date, and 2650 acres proved to be productive.

Currie. The highest-gravity crude oil produced from the Woodbine in the Mexia fault zone was discovered December, 1923, at Currie in Navarro

A typical Christmas tree installation in the Hilbig field, central Bastrop County

County. Production was found at almost as shallow a depth as at Mexia, wells finding the pay at 2970 feet. Only 29 wells were completed as oil wells, however, proving 375 acres to be productive. It proved to be a minor field, the total cumulative production amounting to 6,300,000 barrels.

Nigger Creek. Another minor field in the Mexia fault zone was opened in July, 1926, on Nigger Creek in Limestone County and proved to be a 3,000,000 bbl. pool. Only 29 oil wells were completed and 170 acres proven productive.

Wortham. Days of the Mexia boom were recalled after the discovery of Wortham in Freestone and Limestone counties on November 22, 1924. It proved to be on the main fault trend between Mexia and Corsicana-Powell, and in the ensuing decade produced 22,000,000 bbl. of crude, the third largest field in the Mexia fault zone from the standpoint of cumulative recovery and proven oil acreage. More than 322 oil wells were completed and 715 acres proved to be productive.

Kosse—The Single-Gusher Oil Boom. One of the most unusual situations ever to occur in East Central Texas was the oil boom that followed the bringing in of a solitary gusher near Kosse in August, 1922. It was the Humphreys-Texas Company's No. 1 Jones fee in Limestone that blew in for an estimated 10,000 bbl. of crude per day. The boom that followed was on the scale of Burkburnett or Mexia. Huge orders for steel tankage were contracted for; pipe lines were laid to trunk oil carriers. Close-in acreage brought as high as $1,000 per acre. Within two weeks 15 derricks were up around the new "strike." But, strangely enough, not another producer was brought in and millions of dollars were sunk into the Cretaceous formations in vain. The spotty character of the Kosse area is accounted for by the fact that the producing pay was from a crevice in the Austin chalk —a characteristic of the Balcones fault zone throughout East Central Texas.

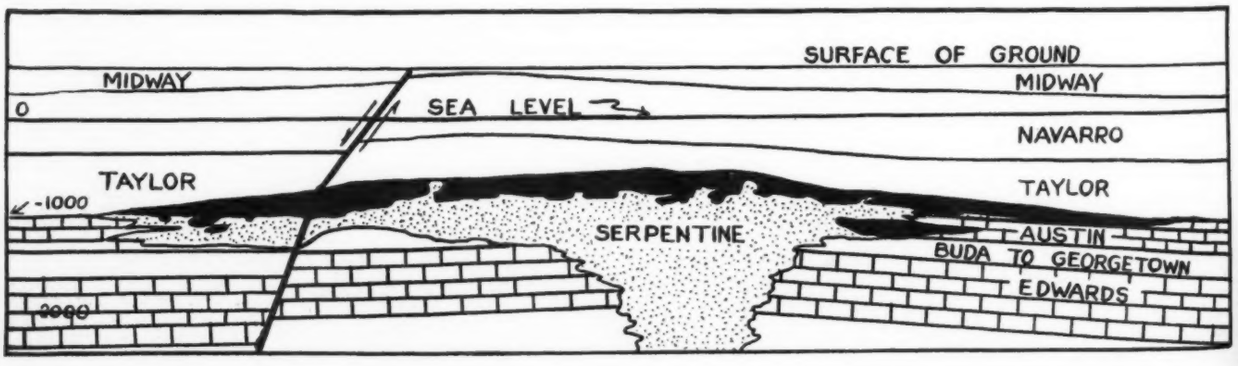
OPERATION

One of the most successful repressuring plants in operation in Texas is the Humble Oil and Refining Companys' installation in the Hilbig field, eight miles southwest of Bastrop in central Bastrop County. Fourteen flowing wells are repressured in the Serpentine formation found at an average depth of 2460 feet. All 14 oil wells are productive today, two and one-half years after the discovery date, and is partly due to use of back-pressure and proper spacing in addition to the repressuring of the sand. More than 250,000 bbl. of oil has been recovered to date. Humble Oil and Refining Company's No. 5 Ed Wilhelm, a typical well in this field in April, 1936, showed a tubing pressure of 150 lb. and a casing pressure of 700 lb., although it has been on production for more than two years. More than 250 acres have been proved productive from a domal type plug, interrupted by a local fault. The Humble has been very successful in repressuring projects, especially in the Sugarland salt dome oil field of central Fort Bend County and in the Raccoon Bend field of eastern Austin County. The gravity of the crude is 37.1 deg. A.P.I.

South Bosque. One of the oddest sights in Texas fields is the use of windmills for pumping oil wells. This unusual method is in use in the South Bosque field of western McLennan County near Waco and was adopted after a centralized pumping station proved to be unsatisfactory because of the difficulty encountered in cultivating the rich farm lands arising from interference of pumping rods and because of the relatively high cost of operation. To solve the problem, the individual windmills were erected at each of the eight wells. Derricks 30 ft. high were erected over each producer. The entire installation cost the company but $150 per well. No pumper is required; a workman on the farm keeps the equipment in repair.

Production is found in the Lower Cretaceous. It is the only field producing today from that group of formations for a distance of more than 50 miles in any direction. The wells are producing from a depth of 450-460 feet.

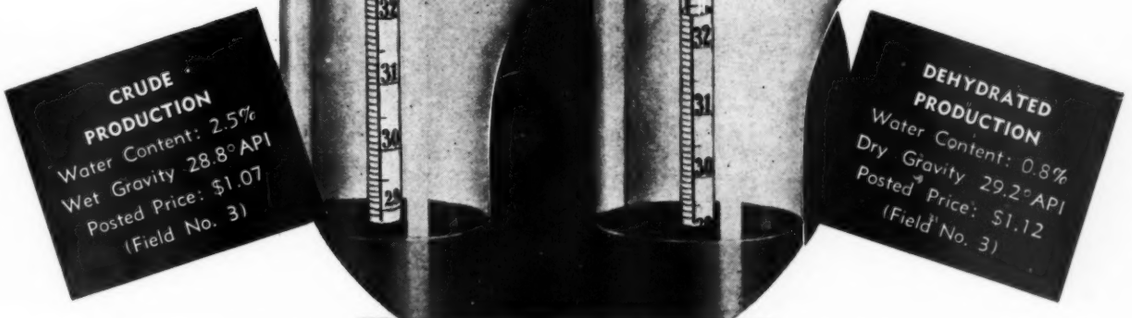
The local cross section shown here illustrates underground conditions in a typical Serpentine producing field. Note how the Serpentine, altered igneous material, has intruded into the Austin chalk, overlapping it and forming sills. This type structure in the United States is productive only in five counties along the course of the Balcones fault zone in East Central Texas



GRAVITY

IS EMINENTLY IMPORTANT TODAY

From th[illegible]tandpoint



No producer can examine the table of crude oil prices at the well today without recognizing the importance of maintaining the gravity of his crude production. The loss of from 0.1°API to 1.0°API in gravity means the loss of from 2c to 5c per barrel for the entire production of a well or group of wells.

When crude production is "cut", even though it is within pipe line requirements, it is always possible by means of Petreco Electromatic Dehydration to restore the loss in gravity that usually results; and at such low cost as to represent a handsome profit on every barrel sold. To illustrate, assume that your production contains 2.5% water and has a wet gravity of 28.8°API, for which the posted price in Field No. 3 is $1.07 per barrel. (See table of crude oil prices at the well.) Dehydration of this crude to 0.8% cut increases the gravity to 29.2° API which is within the next price bracket of $1.12 per barrel—an increase of 5c per barrel for the entire production.

Make gravity tests of your crude frequently and carefully. When the production is "cut" let Petreco engineers determine the results of Petreco Electromatic Dehydration and submit written reports of their findings. This service is rendered without cost or obligation.

CRUDE OIL PRICES AT THE WELL
(May 1, 1936)

Gravity	No. 1 Field	No. 2 Field	No. 3 Field	No. 4 Field	No. 5 Field
20-20.9	.85				.77
21-21.9	.88				.77
22-22.9	.92				.79
23-23.9	.95		.84		.82
24-24.9	.99		.88		.85
Below 25		.86		.78	
25-25.9	1.03	.88	.93	.80	.89
26-26.9	1.06	.90	.98	.82	.92
27-27.9	1.10	.92	1.03	.84	.96
28-28.9	1.14	.94	1.07	.86	.99
Below 29		.94			
29-29.9	1.17	.96	1.12	.88	1.03
30-30.9	1.21	.98	1.17	.90	1.07
31-31.9		1.00	1.22	.92	1.11
32-32.9		1.02	1.27	.94	1.14
33-33.9		1.04	1.32	.96	1.18
34-34.9		1.06	1.37	.98	1.22
35-35.9		1.08	1.42	1.00	1.25
36-36.9		1.10	1.46	1.02	1.29
37-37.9		1.12	1.51	1.04	1.32
38-38.9		1.14	1.56	1.06	1.36
39-39.9		1.16	1.61	1.08	1.40
40-40.9		1.18	1.66	1.10	1.43

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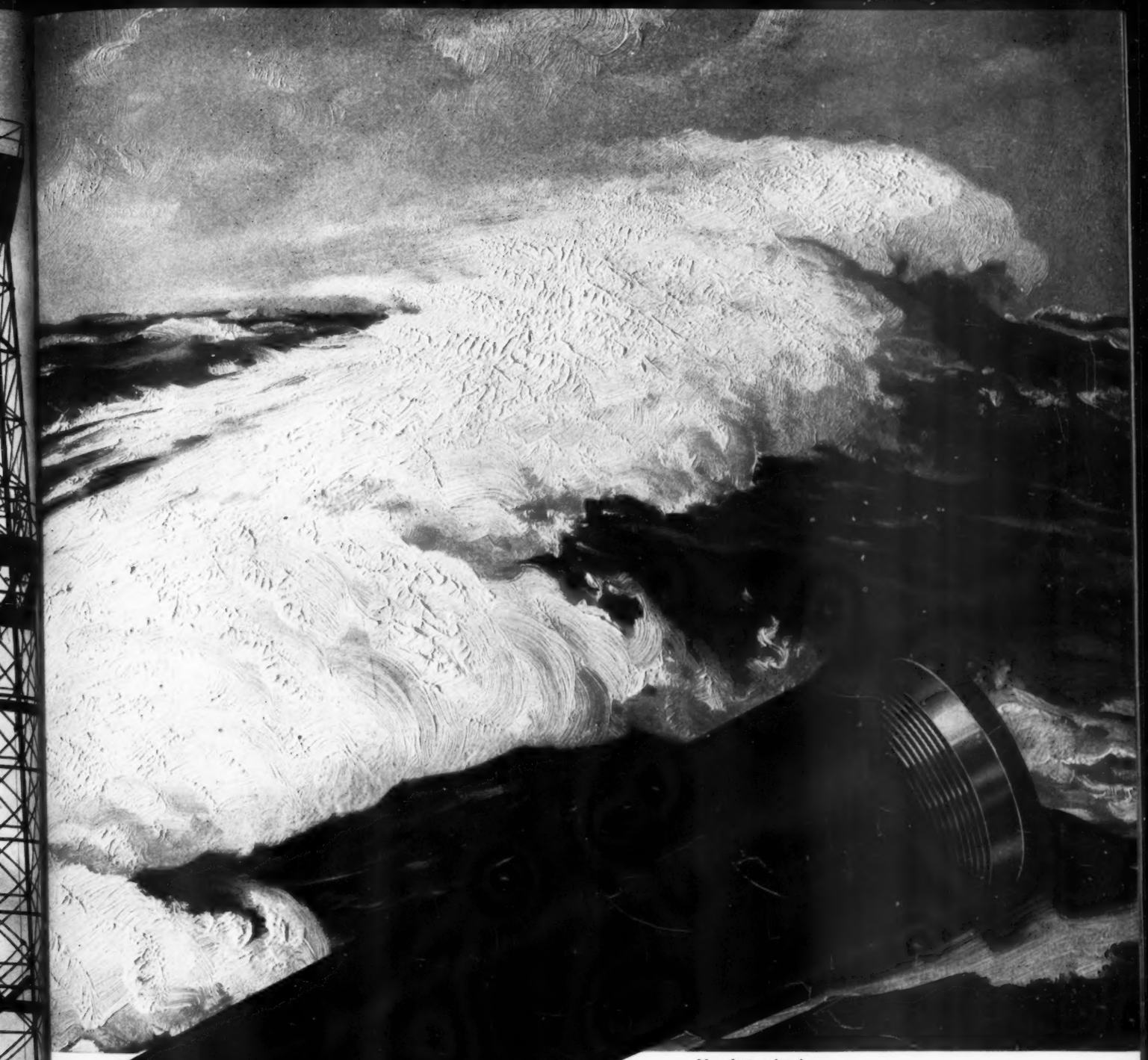
★Also in the active Oklahoma City oil field 6,458 feet of 9-inch, 38-pound HIGH-YIELD CASING were run in Guthrie No. 1—illustrated at the right.



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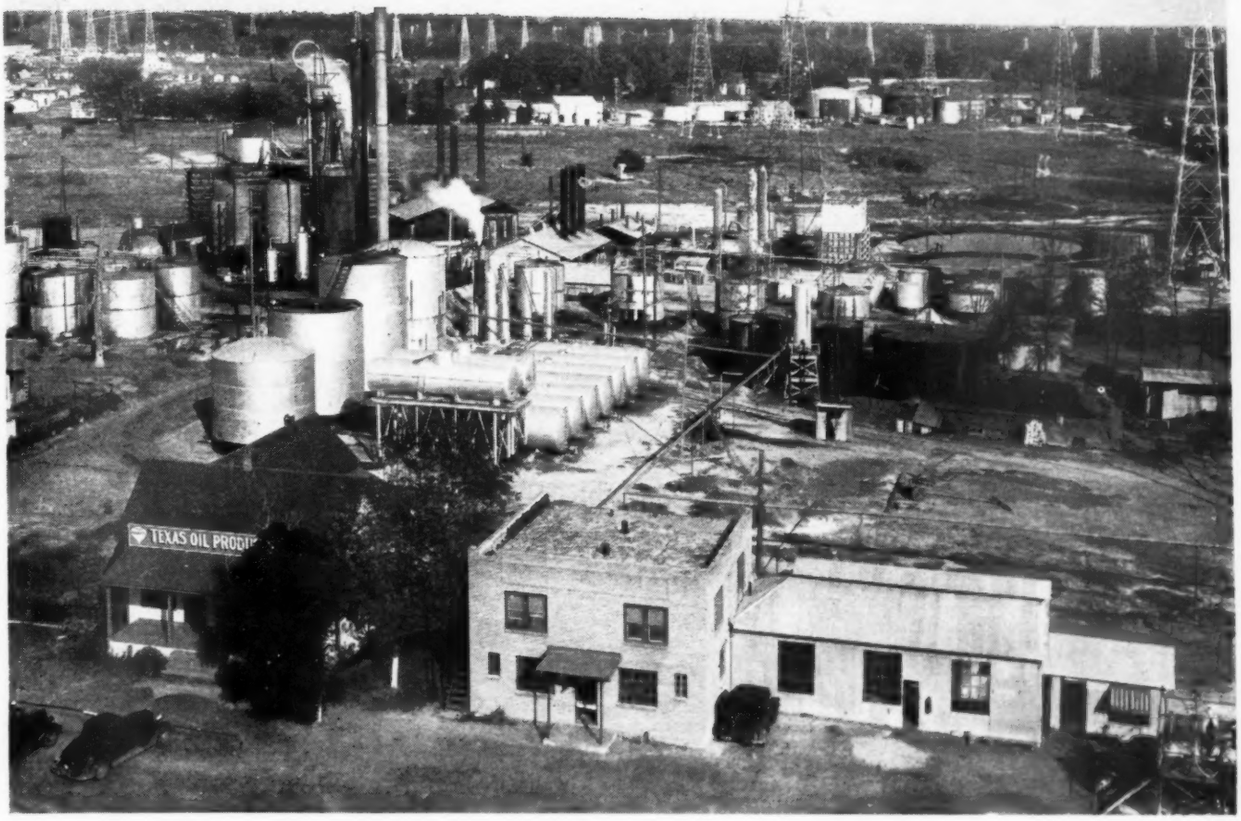


One of the many refineries operating in the East Texas field

Review of Petroleum Development in East Texas

INTRODUCTION

WHEN C. M. "Dad" Joiner, a lone wildcatter, brought in his discovery well—No. 3 Daisy Bradford in Henderson County—one fall day in 1930, little did he realize that he had opened the faucet of the world's greatest oil field. He was a modern Aladdin, rubbing the lamp to reveal the greatest reserve of oil in the Lone Star State. In only a few months, the once isolated region of Dixie became the mecca in the greatest oil boom in the history of the oil industry. It was in a region long condemned for oil possibilities, where the elusive crude was so well concealed from the geologist, the geophysicist, where even the lack of seepages and surface structure made its detection and existence dormant. It was a modern Spindletop in boom characteristics but a colossus in proportions—124,000 acres sprawling over five counties, 63 miles in length, and from four to seven miles in width, holding a reserve of six billion barrels, of which four billion was to be recoverable. Its discovery was all the more remarkable since oil prospecting had been in effect in Gregg County and adjoining areas since 1911, nearly two decades.

The discovery was made October 3, 1930, at No. 3 Daisy Bradford fee in the Juan Ximines survey, approximately six miles northwest of the town of Henderson in Rusk County. On the night of October 3 the well started flowing at an estimated daily rate of 300 bbl. of 37-gravity oil from pay sand found from 3536 ft. to 3592 feet. The strike was made after Joiner skidded the rig twice because of junked holes on two other tests on the 975-acre farm. No. 1 Bradford was abandoned on January 10, 1928, as a junked hole at a total depth of 1097 feet. His No. 2 Bradford in the same survey was abandoned on May 4, 1929, at a depth of 2528 feet. For more than three years the development had been under way, featured by frequent shutdowns due to lack of funds.

Geologists, noting the pay to be true Woodbine pinching out eastward against the regional Sabine uplift (a dome 80 miles in diameter), reasoned that the beach-sand, shoreline would swing around the periphery of the gigantic uplift to connect with the old Caddo field, also productive in the Woodbine, some 75 miles to the northeast. Mr. Groginski, a Fort Worth geologist, interested Ed Bateman and associates in drilling southwest of the town of Kilgore on the Mrs. Lou Della Crim land, 11 miles north of the Joiner discovery. The day before Christmas in 1930 Santa Claus virtually proved no fantastic illusion to the impoverished agricultural communities in the Kilgore vicinity when a 12,000-bbl. producer was brought in by the Bateman interests. The operators sold the well and the block of 1500 acres on which it was situated to the Humble Oil and Refining Company (Standard Oil Company of New Jersey subsidiary) for a total consideration of $2,100,000, of which $1,600,000 was in cash and the remainder to be paid out of oil.

Meanwhile, with the Bateman well still drilling, another semi-wildcat had been started 14 miles farther north and east. Moncrief, Farrell, and Arkan-

Gladewater, Gregg County, as it appeared January 9, 1932. It was the

sas Fuel Oil Company's No. 1 F. K. Lathrop came into production for 7000 bbl. from the identical formation found in the Joiner and Bateman discoveries. Yount-Lee Oil Company of Beaumont, Texas, progressive independent of the Gulf Coast region, purchased a one-half interest in the well and in the 2600-acre block for a total consideration of $3,500,000 in cash and oil.

One of the fastest leasing programs ever carried on in the oil industry occurred with lightning-like rapidity as the entire 30-mile belt between the Moncrief-Farrel and Joiner discoveries was leased up by major companies paying more than $30,000,000 for the acreage mapped in the shoreline belt.

Overnight the villages and towns in a ten-county area were revived with prosperity and development. Henderson, county seat of Rusk County, nearest to the Joiner discovery, developed into a community of 10,000 people within a few months as the largest oil boom in Texas burst into fever heat. Kilgore, formerly a village of only 200, became a town of 9500 by New Year's Day of 1931. Longview, listed with a population of 5025 at the beginning of the boom, suddenly developed to a city of some 20,000 population.

The boom came "just in time," declared the fee owners who were fortunate to be situated along the course of the shoreline. Two successive droughts had occurred just prior to the discovery. Hundreds had been forced to mortgage their farms and livestock long before "Dad" Joiner brought in his memorable discovery well in the fall of 1930.

Upshur County Extension. The East Texas field was extended into Upshur County on May 5, 1931, when Mudge Oil Company's No. 1 Richardson estate in the David Ferguson survey came in for an initial production of 274 bbl. of pipe line oil in two hours, producing through a 42/64-in. choke. Saturated sand was found from 3721 ft. to a total depth of 3743 feet. It marked a two and one-half mile extension, nearest production previously having been Sultan Oil Company's No. 1 Thrasher in the Lathrop pool.

Martial Law. To cope with unsettled conditions existent at the time, Governor R. S. Sterling on August 17, 1931, declared martial law over the field and shut in 1642 producing wells.

The Governor's proclamation read in part:

"As evidenced by a telegram in my hands from the sheriff of Rusk County, the sheriffs of the counties in the district defined have not a sufficient force, and under the very nature of our Government could not have a sufficient force to compel operators and producers of crude petroleum oil and natural gas to obey said law, it being utterly impossible with the forces at the command of the sheriffs or other civil authorities to enforce either the order of the Railroad Commission of Texas or the laws pertaining to the waste of crude petroleum oil or natural gas against an entrenched group of insurrectionists such as are violating the law in the territory defined, and that;

"By reason of the reckless, unlawful and criminal handling of producing wells in said district, water is being rapidly drawn into the oil sand, thereby creating enormous physical waste of crude petroleum oil, and more than 1,000,000,000 cu. ft. of natural gas, rich in gasoline content, are being wasted, all of which causes a great loss of revenue to this state . . ."

The martial law order, however, was not without precedent in the Mid-Continent oil-fields. Only 12 days before, Governor William Murray of Oklahoma had issued a similar order shutting in all 3106 prorated oil wells throughout Oklahoma.

The Texas proclamation involved 1625 producing wells in the four counties (then productive), embracing an area of 2815 square miles, 94,000 acres of proven oil territory and an actual daily production of 738,000 barrels.

Martial law did not affect the operations of drilling wells, movement of stored oil, or the running of stored oil by pipe lines.

Guardsmen, 1200 of them, were placed on duty in the East Texas field to put into effect and execute the proclamation of martial law. Approximately 750,000 bbl. of oil per day were withheld from production as 1642 wells were shut down.

Even on the first day, a well was found flowing south of the town of Overton in western Rusk County. Guardsmen, by means of the flambeau or gas flare, spotted the well of Lively & Bryant's No. 1 Cox producing. An employee at the well, Eddie Mayer, was arrested by one of the Texas Rangers accompanying the soldiers. The man was placed under arrest and marched to Kilgore where he was reported placed in the guardhouse at the headquarters camp. However, Mayer declared that he did not know of the existence of martial law and convinced officers sufficiently that he was released at 9:30 o'clock that night.

General Wolters reported that the well had been flowing, as were several other wells in the Joiner area in the south end of the field.

The indicated cost of maintaining martial law in the East Texas field was estimated at Austin as being approximately $4380 per day. The actual cost for martial law enforcement at Borger in the Panhandle in 1929 was $15,099 for the 23-day period when 97 caval-

scene of the greatest townsite drilling orgy of any locality in the field

rymen were on duty in the oil and gas fields there. Actually, 1265 soldiers were active in the East Texas field while it was shut down. The number was later reduced to 709.

The city hall at Kilgore was converted into general headquarters for Gen. Jacob F. Wolters and his troops.

The East Texas field remained shut in until September 5, 1931, a 21-day shutdown. Upon being reopened, the well allowable was established at 225 bbl. per day. At the commencement of the shutdown crude had been posted at 20 cents per bbl. by the Humble Oil and Refining Company. However, after the field was reopened, the price was advanced to 68 cents per barrel. Almost two months later, November 2, 1931, East Texas crude oil was increased in price 15 cents per bbl. to bring the price to 83 cents. For many months the field remained under martial law even though the shutdown period was over.

A Major Catastrophe. The second greatest catastrophe in Texas oil history occurred April 29, 1931, two miles southeast of Gladewater. Sinclair Prairie Oil and Gas Company's No. 1 M. T. Cole, while being brought under control, ran wild, flowing an initial daily output of 15,000 bbl. of oil and 5,000,000 cu. ft. of gas. For 30 hours the well defied all efforts to subdue it. Two drilling crews had it almost in check when the casing elevators, which had been raised by the pressure of the gas column, suddenly swung around, hitting a derrick-beam. A spark was struck, there was a thunderlike detonation, and what amounted to a blast furnace was started. For more than 30 hours the wavering column of crude had soaked the countryside, laying the barrage for the inferno that was to follow.

Fire dominated the situation for the next eight days. During the first ten minutes of the disaster, the 122-ft. steel derrick crashed to the ground as the girders melted in the intense cauldron-like heat. The rig became a twisted mass of rotary tools, chains, and drawworks. After the fire had consumed almost 200,000 bbl. of oil, fire-fighters succeeded in extinguishing the cauldron, two shots of nitroglycerine proving successful.

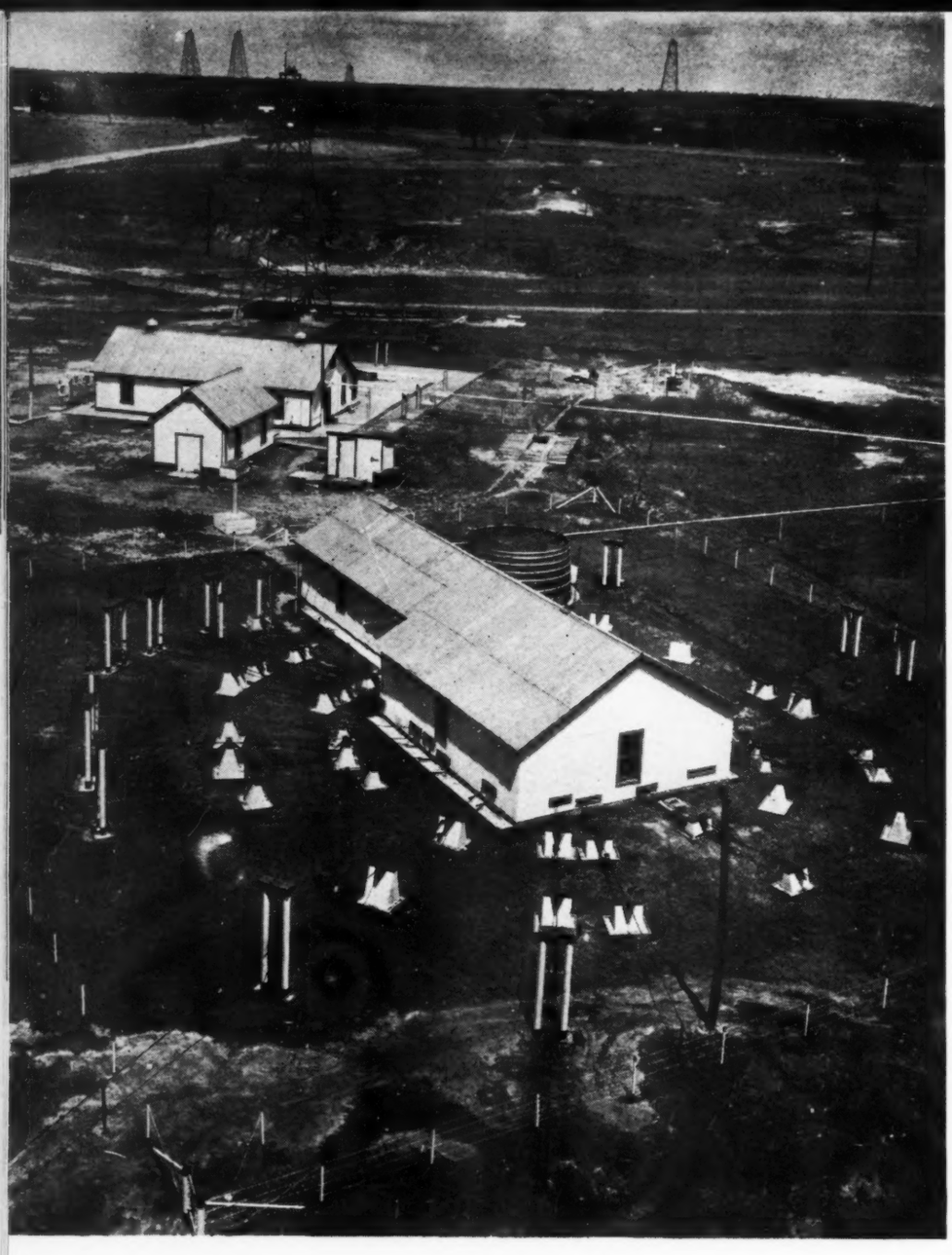
A 26-day Fire. Perhaps the longest-burning well fire in the East Texas field was the Bell & Graddy well, which burned for 26 days after catching fire in June, 1932. Finding it futile to extinguish the fire at the surface, workmen constructed a 170-ft. tunnel leading to a point on the casing 25 ft. below the surface. After cutting a hole into the casing, they turned a stream of water into it. Fifteen minutes later their battle was won. In another 15 minutes they "killed" the well by pumping mud into the casing. Workmen then approached the well and began installing new control heads, preparatory to swabbing the well and bringing it in under control.

HOT OIL

For more than four years, a recurrent flood of "hot oil" has emanated from the East Texas field periodically demoralizing the refined products market, threatening economic destruction to legitimate oil operators and marketers through constant ruination of the price structure upon which the legitimate industry is based.

TYPICAL COLUMNAR SECTION
EAST TEXAS OIL FIELD

System	Series	Group	Formation
Tertiary	Eocene	Claiborne	Cook Mtn. — Saline Bayou, Milams, Crockett, Sparta
			Mt. Selman — Weches, Queen City, Reklaw, Carrizo
			Wilcox Sands
			Midway Shales
Cretaceous	Gulfian		Navarro Sand Pecan Gap Chalk Wolfe City Sand Blossom Sand Austin Chalk Eagleford Shale Sub-Clarksville Woodbine Formation
	Comanchian	Washita Fredericksburg Trinity	Buda Lime, Del Rio Clay Georgetown Lime Glenrose, Lower Trinity Sands



One of the largest central power plants in the East Texas field. Although the capacity is 19 shackle lines, only 14 were in use at the time this photograph was taken.

"Hot oil," it may be explained, is comprised of all crude oil produced in excess of the current proration allowable; and/or all oil obtained through actual theft from other owners' wells, pipe lines, lease tanks, and storage tanks.

The total volume of "hot oil" produced in the East Texas field since May, 1931, when proration there was first put into effect, has been conservatively estimated by authorities as being in excess of 80,000,000 bbl. (to January, 1936). The total amount of legally-produced oil has exceeded 700,000,000 bbl., as it is estimated that 600,000,000 bbl. of recoverable oil remains in the East Texas reservoir.

"Hot oil" produced in excess of allowable is obtained in various and sundry ways. Dummy well connections have been installed by certain unscrupulous operators on partly-developed leases at undrilled locations to obtain unfairly additional allowables for the lease. Dead or depleted wells are often included in the list of producing wells with allowables obtained from other producers on the same lease. It is reported that wells have been leased out willingly by certain well owners to "hot oil" refiners for a specified sum per diem in return for running of production in excess of allowable—amounting to sales of huge volumes of crude oil under the posted price.

In common law theft, the most predominant method is the use of by-pass lines attached to either the well connections or to flow lines or to lease tanks. Another method is the frequent tapping of pipe lines of purchasing companies. Still another method in use is the stealing of oil from lease tanks by employing long lines of hose, through which the oil is taken under cover of darkness and pumped into auto trucks of fly-by-night gangs. The stolen oil is later sold to "hot oil" refiners at considerably below the posted price.

The malignant effects of "hot oil" are felt by:

1. Thousands of royalty owners in all parts of the nation, comprising all walks of life, who fail to benefit from production taken illegally from beneath their own tracts.

2. Legitimate refiners (paying the $1.15 per bbl. posted price for crude oil), who are placed in a position unable to compete with the "hot oil" refiners that obtain their supplies 60 cents below the market price.

3. Large marketing companies who are forced to lower the price of their products to unprofitable levels in order to meet competition from retailers of gasoline made from "hot oil" and sold below the current market price. (Offering crude at 60 cents below the market price to refiners by "hot-oil" producers makes possible a shading of gasoline prices to jobbers, who in turn pass the price differential advantage on to wholesalers who in turn share the price advantage with retailers. Thus a large volume of products made from "hot-oil" has moved through the middle-west market with resultant trade demoralization.)

The Railroad Commission of Texas, being delegated authority, has from time to time originated and placed in effect various plans devised to stop the production and shipment of illegally-produced crude oil and products refined therefrom.

A most practical plan was the creation of a state tender board to pass on the legality of all oil tendered for railroad shipment. Railroads were required to demand tenders from refiner shippers accompanied by affidavit that the products were made from legally-produced crude oil. The Railroad Commission during 1933 also required operators to file reports stating the amount of oil run from each well daily and its destination. So effective was the plan during October, 1933, that as many as 300 operators were disconnected from pipe lines as a result of failing to comply. Pipe lines were permitted to reconnect only when the "EB" oil report, as it was designated, was filed with the Railroad Commis-

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Stores Everywhere

sion, and in good order, after being notarized. The state highway patrol coöperated with the Railroad Commission by instructing its patrolmen in East Texas to examine all bills of lading and tenders of oil and gasoline trucks as they traveled over the highways that cross the East Texas field. The examination is made at the time a truck is stopped for inspection of its equipment and weight for possible violations of highway laws.

In 1935, the Department of the Interior created the federal tender board whose duty it is to pass on the adequacy of tenders of oil destined for interstate shipment.

Geology. The East Texas field's oil and gas accumulation is due to an eroded shoreline condition in the Woodbine formation, which shows the east boundary of the subsurface position on the west flank of the Sabine uplift cut back from its original position being thus truncated and capped by the Austin chalk, unconformably and disconformably. The structure is influenced by two regional terraces, one west of Henderson and the other at Gladewater. The depth of the producing portion of the field lies between minus 3090 ft. (subsea level) on the eastern side of the field and minus 3323 ft. on the west side of the field. On the extreme northern sector of the field in the Jamestown area, a lower sand lens, entirely separate from the main producing sand body is productive at an interval of 22 ft. below that of the west edge or at minus 3355 ft. (subsea level), as discovered by Cranfill & Reynolds' No. 1 Rash.

Stratigraphy. The East Texas field pay in the Woodbine sands is due to truncation and erosion and wedging out of a group of several sand lens, interconnecting in nature comprising the Woodbine formation, but overlapped by an erosional beach sand, containing much silt, water-laid volcanic ash, and covered with deposits of laminated shale, lignite with the Austin chalk as sealing medium. The Eagleford shale and its lower phase, the Sub-Clarksville, are not ordinarily found in the producing area of the field, but are encountered basinward, due to the angular unconformity of the Austin chalk over the truncated Woodbine surface. Although the various sand lens are interconnected, and reflect simultaneously (and more or less uniformly) the various changes in reservoir pressure, yet these sands become more distinct basinward with red shale stringers separating different lens and a 25-ft. thickness of true Red

ACTIVE REFINERIES. The following list of East Texas refineries shows the latest daily average refinery crude runs for the month of April, 1936:

Name of Operator	Plant Location	Daily Capacity (Bbl.)	Average Daily Runs (Bbl.) (April, 1936)
Acme Refining Company	Gladewater	1250	....
Adams Refining Company	Big Sandy	1000	....
Admiral Refining Company	Kilgore	2500	1700
Artex Refining Company	Arp, Smith Co	2000	....
Bartlett Refining Company	Kilgore	2500	....
Beacon Oil and Refining Company	Henderson	4000	240
Blue Diamond Refining Company	Gladewater	1500	....
Bradley Refining Company	Kilgore	2000	....
Cascade Refining Company	Reeds Switch	3000	1150
Central Refining Company	Gladewater	2000	220
Century Refining Company	Friars Switch	2500	....
Chief Refining Company	Gladewater	2000	1370
Clay Refining Company	Arp, Smith Co	2500	1730
Danciger Refineries, Inc	Longview	10000	3500
Deason Refining Company	Turnertown	500	....
Dominant Refining Company No. 1	Kilgore	4000	....
Dominant Refining Company	Kilgore	2000	....
East Texas Cracking Company	Camp Switch	4200	....
East Texas Refining Company	Longview	8000	5000
Gilliland Refining Company	Gladewater	4000	2650
Gilliland Refining Company	Overton	5500	2415
Gilmer Refining Company	Gladewater	1000	....
Godlin Refining Company	Gladewater	500	....
Heath Refining Company	Camp Switch	1000	....
Holmes Refining Company	Gladewater	1500	....
Hub Oil Refining Company	Reeds Switch	3000	....
Hurricane Petroleum Corporation	Overton	4500	4200
Johnson Refining Company No. 1	Kilgore	1200	....
M. S. Johnson Refining Company	Gladewater	1250	....
Keystone Refining Company	Gladewater	1000	....
Kilgore Reclamation Company	Kilgore	3000	....
Lake Refining Company	Gladewater	2500	1580
La Petite Refining Company	Joinerville	800	....
Lapren Refining Company	Kilgore	2500	....
London Topping & Refining Co	Overton	1000	....
Lotus Refining Company	Overton	1000	....
Matthews Refining Company	Gladewater	1000	....
McKain Refining Company	Gladewater	1500	....
McMurray Refining Company	Arp, Smith Co	4000	1250
National Refining Company	Camp Switch	1000	....
North Texas Refining Company	Gladewater	1500	....
Ocean Refining Company	Kilgore	2300	1830
Outdoor Refining Company	Kilgore	900	....
Overton Refining Company	Overton	3000	....
Ozazo Refining Company	Friars Switch	1200	....
Panama Refining Company	Kilgore	3000	1000
Pope Refining Company	Gladewater	1500	....
Premier Oil Refining Company of Texas	Greggton	4000	3000
Rusk Oil & Refining Company	Overton	4000	550
Shoreline Refining Company	Kilgore	4000	....
Sinclair Refining Company	Camp Switch	3500	2000
Solvex Refineries, Inc	Gladewater	4500	3000
Southern Oil Refining Company	Reeds Switch	2000	1000
Southport Refining Company	Kilgore	5000	1650
Stag Refining Company	Kilgore	1200	....
Supreme Refining Company	Gladewater	1200	....
Swastika Refining Company	Kilgore	3000	250
Texas Oil Products Company	Gladewater	3000	2370
Texas State Refining Company	Kilgore	1000	....
Trinity Refining Company	Gladewater	6000	2180
Trio Refining Company	Arp	2500	850
Tyler, Texas Refining Company	Tyler	15000	980
Tower Refining Company	Overton	3000	1900
Union Refining Company	Kilgore	3000	....
Utah Refining Company	Kilgore	3000	....
Wabash Refining Company	Gladewater	1000	440
Wichita Refining Company	Gladewater	1000	....
Wilemon Refining Company	Overton	1000	....
Witeners Refining Company	Gladewater	1500	....

Recapitulation

Location	No. Plants	Location	No. Plants
Gladewater	22	Big Sandy	1
Kilgore	18	Joinerville	1
Arp	4	Henderson	1
Camp Switch	4	Reeds Switch	3
Overton	8	Greggton	1
Longview	2		
Turnertown	1		
Friars Switch	2	Total	48

Beds as demarcation between the Upper and Lower Woodbine formation. Drillers have encountered producing Woodbine sand at different intervals beneath the Austin chalk base, varying from 2 ft. to 45 feet.

Wells start in the basal Eocene, reach the Navarro at about 2200 ft. (on the east side), find the Pecan Gap chalk from 2600 ft to 3025 ft. and then encounter the Austin chalk at 3500 ft., penetrate a thickness of 42 ft., and pass directly into the Woodbine, Eagleford, or Georgetown, depending upon position. Intercalated in the Woodbine formation are black shales, chocolate-brown shales, glauconitic sandy shales, frequent beds of pyrites, much volcanic ash, and lignite beds of extremely fine thickness. East of the field, the drill passes from the Austin chalk to the nonproductive Geogetown lime.

Pay Sand. Production has been obtained from as thin a body as ten inches of saturated sand, such as on the extreme east edge of the field, to as great a saturation as 40 ft., such as on the west side of the field. The average estimated thickness of saturated sand is 38 feet.

DRILLING METHODS

Equipment. Whereas development of the field from 1930-33 was characterized by use of equipment of comparatively light weight, a trend towards the use of heavier equipment came into reality in 1933 when leading contractors developed the practice of using unitized drawworks, high boiler pressures, and larger drawworks, etc., in the effort to speed-up the rate of drilling, prevent breakdowns, and avoid fishing-jobs. Steel 90-ft. derricks with relegged base were adopted by many leading contractors and operators with heavy drilling programs. The derrick base was 20 ft. by 20 feet. One contractor used a 9-in. roller-bearing Lucey drawworks, the largest in the field, on 3800-ft. contracts. The slush pump was 18 in. by 7¾ inches. Three 100-hp. Lucey boilers of 350-lb. working pressure were used although not more than 250-lb. pressure was carried. A 27-in. Lucey rotary tab'e featured the installation, and a 30-ft. kelly joint was used in connection to save time. The water pump had a 4-in. suction and a 3-in. discharge, and was driven by a 15-hp. gasoline engine that consumed 55 gal. of gasoline each 24 hours. A 6-sheave traveling block was used to handle the 4-in. drill pipe. Using heavy-duty equipment, John Coats, contractor, rigged up and drilled to a total depth of 3627 ft. in only six days.

Casing and Tubing Program. Standard practice is to set 80 ft. of 10-in. surface casing. No protection strings are used. The production string, averaging 3700 ft. in length, is of 5 3/16-in. pipe. In the early days of the field some operators used 7-in. O. D. pipe. Wells are usually tubed with 2-in. tubing.

Drilling Speeds. Ordinarily a well can be spudded and drilled to the pay sand in ten days. However, one speed record was made in the Spring Hill area in Gregg County at J. B. Beard's Farrell lease where 1580 ft. of hole was drilled in 12 hours using a light rig and two boilers.

PRODUCTION

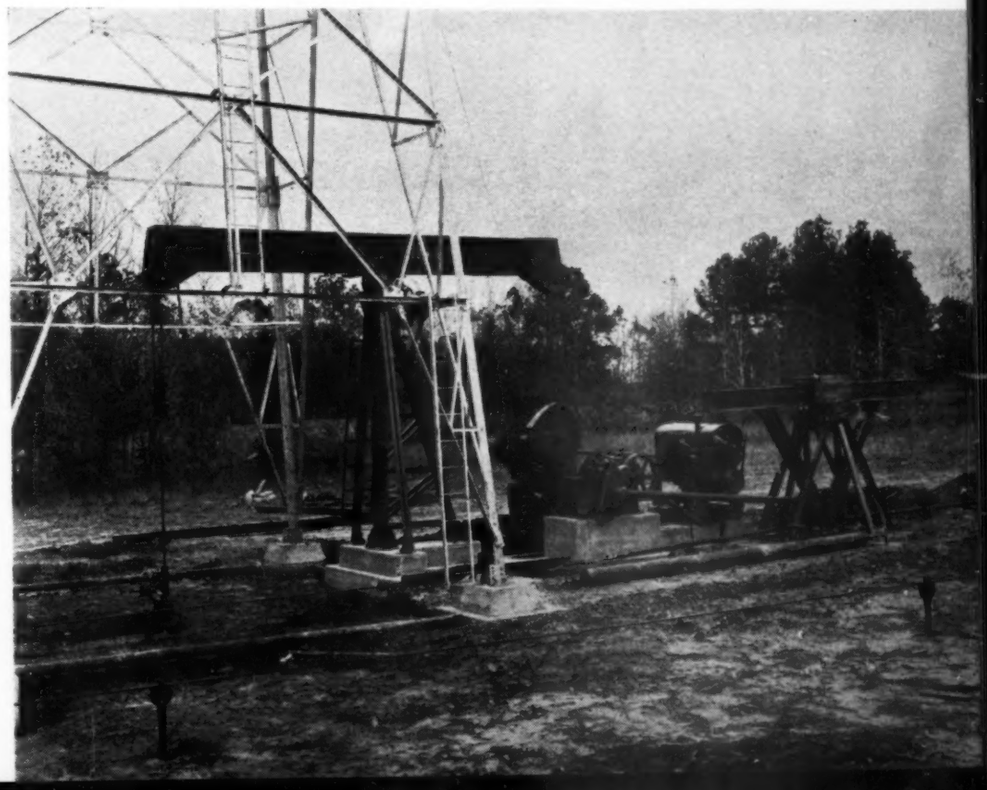
Salt Water Disposal. Use of earthen pits to evaporate salt water produced with crude oil, a major problem in the East Texas oilfield, was widely used by the Gulf Oil Corporation, which spent more than $1,500,000 for prevention of pollution of fresh water streams, soils, and vegetation. A series of salt water pits was constructed for cycling the salt water from one pit to another to cause evaporation. Thereafter the water is returned to an outpost well and reintroduced into the Woodbine sand below the 3320-ft. water level. Evaporation is speeded up by the placing of flares in the midst of the salt water storage pits, i. e., flares leading from producing wells.

REFINING

Refineries in Operation. On January 27, 1936, 24 refineries were in operation and 41 were shut down in the East Texas field, according to records of the Railroad Commission. Those operating were: Artex No. 1, Cascade, Central, Chief, East Texas, G. & P. Gilliland No. 1, Gilliland No. 2, Hurricane, McMurrey, Matthews No. 1, Ocean, Premier, Sinclair, Solvex, Southport, Texas Oil Products, Trinity, Trio, Tyler Texas, O. & R., Tyreco No. 1, Tyreco No. 2, Utah, and Wabash. At the time, the Commission had dropped ten from their list of refineries that were shut down.

PIPE LINES

Summary. Fourteen crude oil trunk pipe line systems handle on an average of 400,000 bbl. per day from the East Texas field. In less than 12 months time, from the date of discovery, 18



Pumping installation with back-side crank and counterbalance swing takeoff on Sam Cooks Sheroul lease, East Texas field.

The NORVELL-WILDER MAN SAW IT GROW

IN the 25 eventful years that Norvell-Wilder has served the oil industry, it has seen Texas production grow from less than ten million barrels of oil in 1910 to over a third of a billion barrels of oil in 1935.

IT has seen Texas grow from a comparatively insignificant oil state to the leading oil state in the nation by far. Last year 11,906 wells were completed in Texas which was more than in all the other oil states of the nation put together. The significance of Texas' leadership is further emphasized by noting that the next highest state completed 2,320 wells.

IT was the privilege of the Norvell-Wilder man to watch several companies, originating in Texas, grow from small beginnings to the leading oil companies of the world. The Norvell-Wilder man is especially proud of the fact that he has served these companies and that his own company has kept pace with their growth and needs.

HE HELPED THEM CONQUER

THE pains of birth, of growth, and of survival in the oil industry are many. There is no other industry subject to such rapid growth in both science and organization. To drill an oil well requires engineering ability and resourcefulness not equaled in any other line of endeavor. Think of an industry where every kind of engineering ability is used in a practical way every day. Think of an industry where the depth of drilling and its consequent engineering difficulties have increased from one thousand-foot wells just a few short years ago, to wells from a mile to two miles in depth today.

IT **takes courage to conquer in such an industry.** The Norvell-Wilder Man appreciates the fact that he has sat in at the councils of men of practical daring who by use of better equipment, matched equipment, delivered on time by Norvell-Wilder . . . have overcome drilling problems.

EXPERIENCE AND PROGRESSIVENESS COUNT. YOU WILL AVOID THE COSTLINESS OF DELAY . . . YOU WILL SIDE-STEP MANY DANGERS AND TROUBLES BY ALWAYS CALLING THE NORVELL-WILDER MAN *first*

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major pipe lines totaling in excess of 2400 miles were constructed. They had a total daily capacity in excess of 1,000,000 barrels. The present trunk lines are shown in an accompanying table.

American Liberty Line. The first independently-owned coastal pipe line outlet for the East Texas field was completed early in May, 1936, by the American Liberty Pipe Line Company. Their 8-in. line from Rusk to Conroe has a daily capacity of 30,000 barrels. The company has connections totaling 20,000 bbl. in the Kilgore area and other connections at Conroe. Five main-line pump stations feature the installation. The point of origin is four miles north of Kilgore, with the point of destination at a terminal on the Houston Ship channel.

Natural Gasoline Line to Coast. In the spring of 1936, Humble Pipe Line Company began construction of an 8-in. pipe line of all-welded construction extending 200 miles from the East Texas field to Galveston Bay. It was laid for the transportation of natural gasoline, propane, and butane, originating from the Humble casinghead gasoline plant at London in Rusk County to the Humble refinery at Baytown, following the route of the company's oil lines via Groesbeck, Hearne, and Webster. The original capacity of the line is 9000 bbl. per day. At Baytown, Humble has planned the addition of a polymerization plant to be erected during 1936 as an adjunct to its refinery there.

EAST TEXAS BORDER COUNTIES

Another oil and gas region of Texas that is now the scene of deep-seated discoveries in the Lower Cretaceous is the border county area. To date production has been obtained in Nacogdoches, Shelby, Panola, Harrison, Marion, Cass, and Titus counties. Production has been found in the Mt. Selman formation of the Claiborne group, in the Woodbine formation, in the Tokio equivalent, in the Washita, and in Paluxy and Glen Rose phases of the Lower Cretaceous. The Washita production has been developed in Shelby county to date. Blossom oil is now sought.

Nacogdoches. At Nacogdoches, in southeastern Nacogdoches County, the first oil production in the state of Texas was found in 1867, but development lagged until 1894. The excellent lubricating stock obtainable from this

Typical heavy-duty drilling rig used during 1933-36 in the East Texas field.

Long Drill Collars

Casing Suspender and Blowout Preventer Patented

With more than 500 years' actual experience the Executives and the Sales Organization of American Iron & Machine Works Co. are in position to give valuable assistance to contracting and producing operators in oil fields throughout the world—from the deepest to the shallowest.

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Always doing our utmost to help our customers

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As pioneers of the long drill collar we have also kept abreast of drilling developments with our long drill collar as well as all of our drilling tools and equipment.

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When the first wells were drilled in the Oklahoma City field their high pressures required heavy equipment. This casing suspender was developed immediately to meet that need. It has been successful wherever used. It is today the popular casing suspender in the "Mansion" area.

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crude makes possible commercial development even though only stripper production is obtained. An oil mine, the only commercial one of its kind in the nation, is situated near the field. Production is obtained from the Queen City member of the Mt. Selman formation of Lower Cretaceous age.

Bethany. The Bethany gas field of northeast Panola County saw its first Trinity gas discovery May 14, 1930, when Natural Gas Production Company completed its No. 8 J. R. Roquemore in the Ben C. Jordan survey at a depth of 4645 ft. in the Glen Rose member. Initial production was 9,000,000 cu. ft. of gas per day. More than 11 gassers have been completed in this deep gas zone.

Tacoma. A small oil producing area was uncovered in 1933 northeast of the town of Carthage in Panola County. The discovery well was completed in the Winnie Mann survey on the Wooten estate at a depth of 2085 ft. in the Upper Cretaceous, having an initial production of 32 bbl. per day. Two producers have been completed to date in the discovery formation.

Rodessa. The Rodessa oil field of northwestern Caddo Parish, Louisiana, was extended westward into Cass County early in 1936, although a gasser had been completed the year before on the Texas side. Extension wells were completed by R. W. Norton at his No. 1 Rives and his No. 1 Haywood in the Prescilla Evans survey, but the largest completed at this writing is the United Gas Public Service Company's No. 2 Jones in the Ben J. Murray survey, which flowed 72 bbl. of oil per hour through ½-in. tubing choke from the Glen Rose Oolitic lime penetrated to 5985 feet. Tubing pressure was 450 lb., while the casing pressure was 250 pounds.

The Rodessa strike was one of the outstanding developments of 1935 and considerably more than 100 wells have been completed at the 6048-ft. level. Production is from three sands: Hill, Dees, and Young, in the Glen Rose phase of the Trinity formation. The United Gas Public Service Company's I. L. Young No. 1 near the Rodessa townsite has produced to date more than 250,000 bbl. of oil, indicative of the importance of the development, although the crude produces a low-octane gasoline. Production was found below and skirting the Glen Rose gas production (developed during the past five years), and is obtained along the course of a major fault in the Lower Cretaceous.

Thorough seismograph geophysical surveys prepared by five major companies prove the existence of favorable structure in the Glen Rose phase of the Trinity in the vicinity of the town of Lodi in Marion County, Texas. Development accelerated by discovery of Upper Trinity production at Talco in Titus County likely will account for additional exploration in Bowie, Cass, Franklin, Harrison, Red River, Hunt, Hopkins, Morris, and Camp counties in search for Trinity production on both faults and structural domes.

Talco. In March, 1936, a new oil

TRUNK PIPE LINES SERVING EAST TEXAS

Pipe Line Company	Point of Origin	Point of Destination	Size (Inches)
American Liberty Pipe Line	Kilgore	Houston Ship Channel	8
Arkansas Pipe Line Corpn	Castor	Shreveport, La	10
Atlas Pipe Line Company	Longview	Shreveport, La	8
Atlantic Pipe Line Co	Horton	Atreco	10
Gulf Pipe Line Company	Henderson	Port Arthur	Double 8
Humble Pipe Line Company	Longview and Arp	Baytown	Three 8
Humble Pipe Line Company	Longview	Baton Rouge	10
American Liberty Pipe Line Co.	Brightwell	Houston Ship Channel	8
Magnolia Pipe Line Co	Kilgore	Corsicana	12
Magnolia Pipe Line Co	Kilgore	Beaumont	10
Sinclair Prairie Pipe Line	Troup	Colonels Station, enroute to Houston	12
Shell Pipe Line Company	Kinsloe	Houston Ship Channel to Deer Park Refinery	10
Sun Pipe Line Company (Stanolind, part-interest)	Grissom	Nederland, Jefferson Co.	10
Texas Pipe Line Company	Munro	Port Arthur	10
Texas Empire Pipe Line (Empire 37.5 percent, Tidewater 25.0 percent, Texaco 37.5 percent.)	Nettleton	Port Arthur	12

14 Trunk Lines ..... 8-in., 10-in., and 12-in.

Flood conditions in the Sabine River bed necessitated the erection of high steel substructures. Note use of caissons for the two corner foundations nearest the river.

area was opened in northeast Texas with the completion of Housh and Thompson and R. L. Peveto's No. 1 Carr in northwestern Titus County, east of the town of Talco. On first official gauge report, it produced in the tanks 194 bbl. of pipe line oil of 27-gravity during 11 hours. Production, from 4206-4208 ft. was found in the Paluxy sand of upper Trinity age in the Lower Cretaceous formations, making the first production from that sand in Texas. The new strike added Titus to the list of productive Texas oil counties as the 123rd since Spindletop. Its discovery resulted in exploration by the drill in Franklin, Red River, Morris, Delta, Hunt, and Lamar counties.

Mt. Enterprise Prospect. As a result of Rodessa, Talco, and the discovery of Trinity production at Cayuga, the Pure Oil Company in March, 1936, staked a location in southern Rusk County for an 8500-ft. test of the Trinity formations on its 7000-acre block south of the town of Mt. Enterprise. The test is on the south upthrow side of a regional fault of the Jacksonville graben. About the same time, geophysical search was active for Trinity structures (in the lower Cretaceous) in Panola, Shelby, Harrison, and Cass counties.

PIPE LINES

Rodessa. When well completions in the Rodessa field of Cass County, Texas, and Caddo Parish, Louisiana, reached a total of 100 during March, 1936, the following pipe line facilities were in use or nearing completion: The Standard Pipe Line Company of Louisiana, an 8-in. line tying into its main trunk to Baton Rouge, in operation since shortly after the discovery of the field; the Arkansas-Louisiana Gas Company's 90,000-ft. line connecting at Oil City with its line to Shreveport; the Magnolia Pipe Line Company's 13-mile 8-in. line from Pine Island, Caddo Parish to the field; East Texas Refining Company's project extending from Rodessa to East Texas; and the Gulf Refining Company's line from Marion County.

NATURAL GASOLINE

Rodessa. A natural gasoline plant of 50,000,000 cu. ft. daily gas capacity has been completed on the Louisiana side by the Pelican Oil and Gasoline Company. It is situated in section 14, township 23 north, range 16 west on the Sexton lease. East Texas Refining Company has placed in operation a 10,000,000 cu. ft. plant, and others either are under construction or contemplated.

Map of the East Texas district showing relation of the Woodbine interior salt dome basin and producing fields therein

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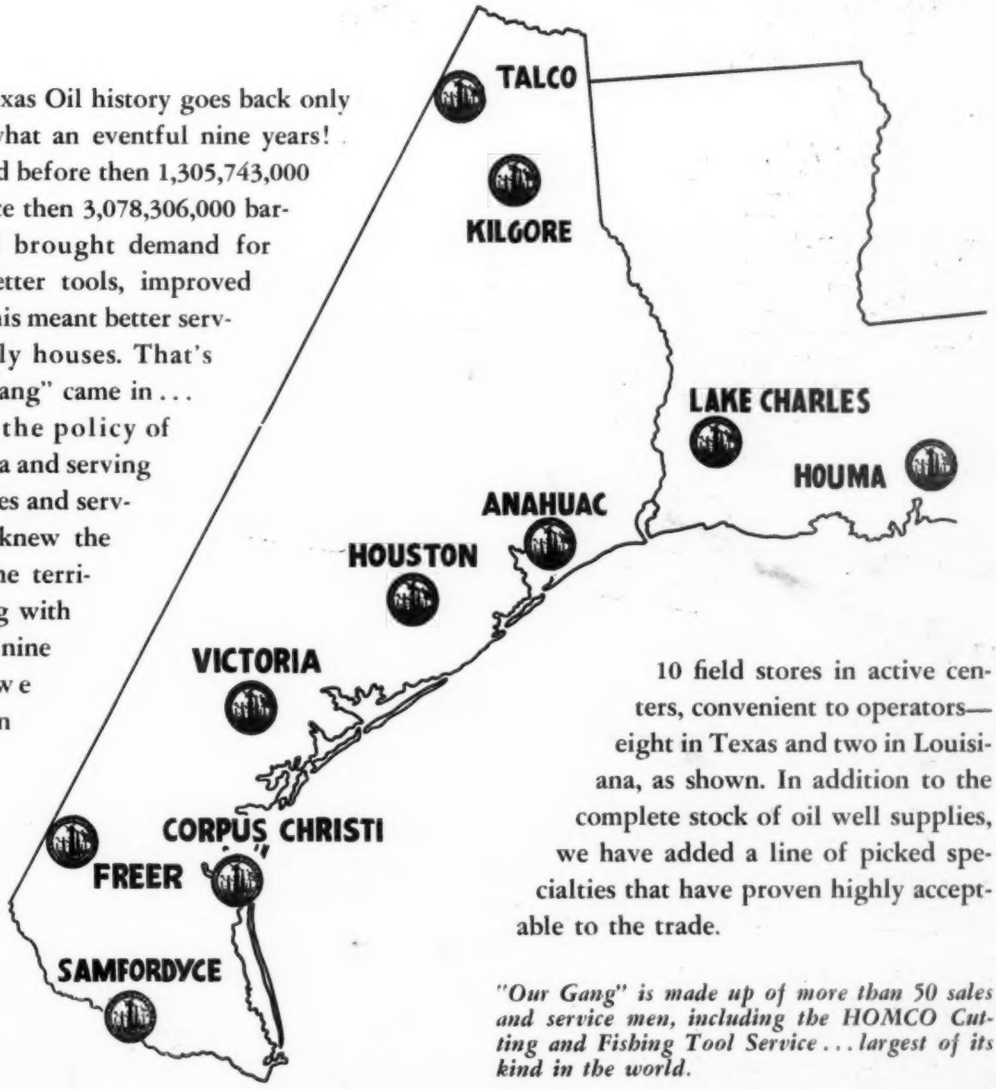
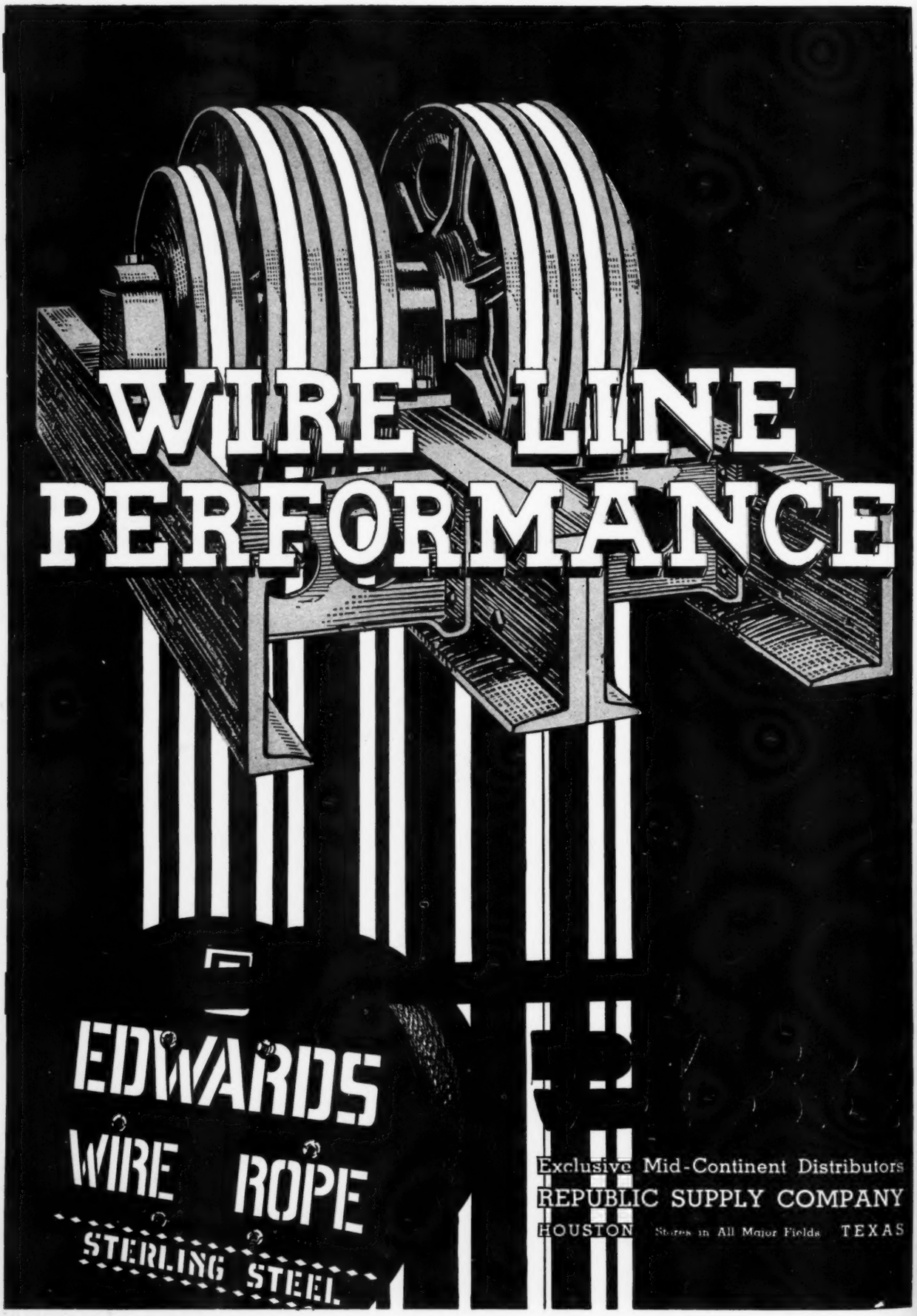
Our part in Texas Oil history goes back only to 1927. But what an eventful nine years! Texas produced before then 1,305,743,000 barrels . . . since then 3,078,306,000 barrels. More oil brought demand for more tools, better tools, improved methods. All this meant better service from supply houses. That's where "Our Gang" came in . . . came in with the policy of serving one area and serving it well, with sales and service men who knew the problems of the territory. Beginning with a single store nine years ago, we now maintain



10 field stores in active centers, convenient to operators—eight in Texas and two in Louisiana, as shown. In addition to the complete stock of oil well supplies, we have added a line of picked specialties that have proven highly acceptable to the trade.

"Our Gang" is made up of more than 50 sales and service men, including the HOMCO Cutting and Fishing Tool Service . . . largest of its kind in the world.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KOBE *hydraulic* PUMP

If I Could Talk to Each Executive across his desk...

HERE IS WHAT I WOULD SAY:

"Your investment in every well is too great to take any chance whatever with equipment for guiding, floating and cementing strings of casing. Your field men know that I'm "tops" in safety and efficiency and they want me on every job.

Of course it's YOUR casing and YOUR well, but if you had been down in wells like I have you'd know what hard knocks and high pressure really are, and be mighty glad to let me take care of things for you."

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Safety and Economy are always present in full measure in every unit of Baker Cement Equipment. You are always certain of a balanced combination of the 3 vital features required for Guiding, Floating and Cementing strings of casing of any length . . .

1—STRENGTH

Baker gives you a heavy seamless steel shoe or collar containing a plug and valve which will withstand any pressures encountered in a well—with an ample factor of safety.

2—VALVE EFFICIENCY

Baker provides circulation areas large enough to permit unrestricted passage of cement but small enough to retain a "washdown" action. The buoyant Bakelite Ball floats in rotary mud or cement slurry and provides an instant, leakproof double-seal against either high or low pressure.

3—DRILLABILITY

Baker alone provides complete drillability with a plug made of concrete and a valve made of Bakelite (set vertically in the plug)—both being materials which are easily and quickly drilled up and circulated out of the hole. You can core immediately below the shoe, or drill safely ahead—no metal fragments ever are present to slow up or interfere with future operations.

Interesting details and illustrations are on Pages 169 to 180 of the 1936 Composite Catalog; or we will gladly send free to any oil man the complete Baker Catalog.

For average conditions use a Baker Cement Float Shoe . . .

plus a Baker Cement Float Collar, if the string is long and heavy.

A Baker Cement Whirler Float Shoe provides the ultimate in cement distribution.

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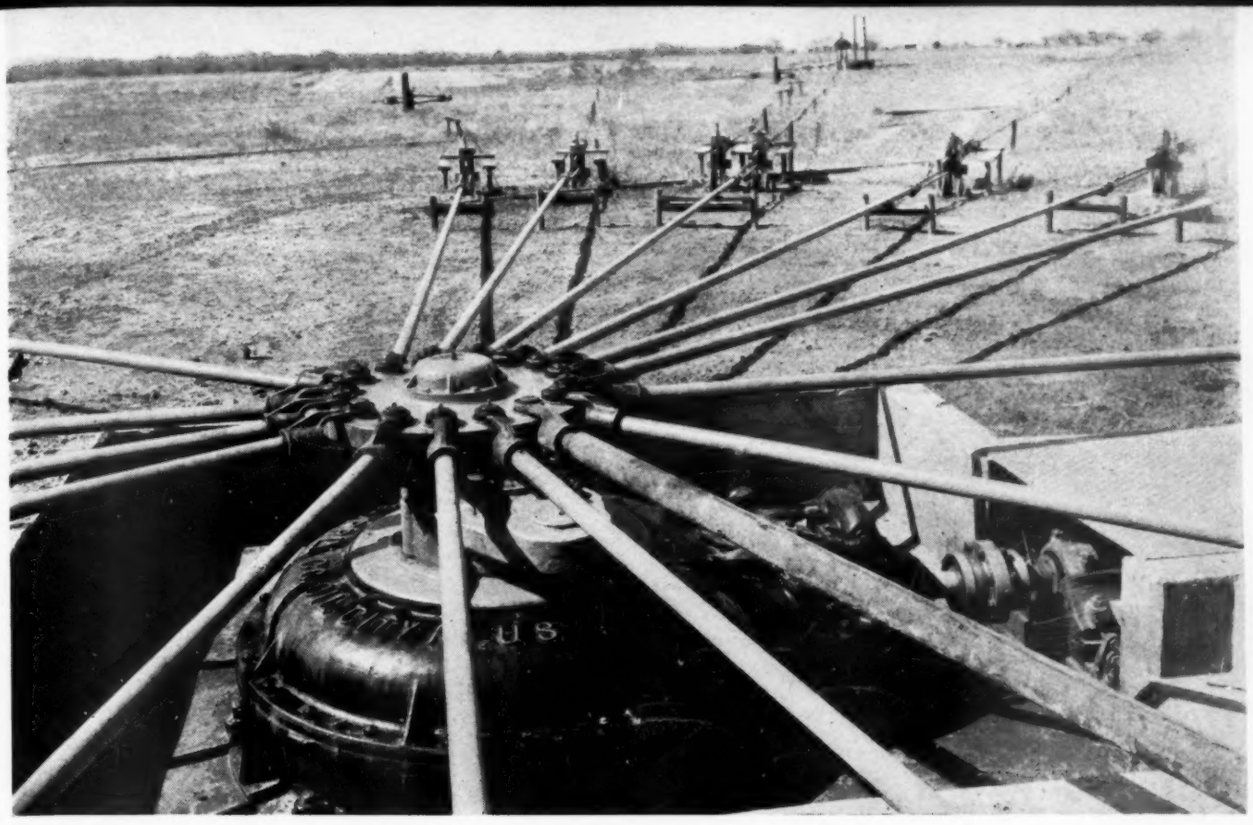
"Well, neighbor, I finally got in to see the boss and told him how good we get along out here on the well. Of course I didn't tell him all about why YOU can do a better job when we're working together, but I sure did tell him that I could take the worries off your mind when you have to set a long, heavy string in an expensive hole.

He's not hard to get along with, and I'll bet if you specify "Baker" on all your requisitions he'll okay 'em from now on, and I'll be with you on every string."

BAKER CEMENT EQUIPMENT



Oilbath geared power pumping 16 2600-ft. wells on lease of Nash & Windfohr Oil Corporation lease near Graham, Texas

Review of Petroleum Development in North Texas

DRILLING AND PRODUCTION

Burkburnett. The history of North Texas oil revolves largely around Burkburnett, named after the town of Burkburnett, which originated from the name of a famed ranch owner. The field, situated in Wichita County, near the Red River boundary line between Texas and Oklahoma, was discovered in 1918, and was followed by one of the most spectacular of drilling orgies. The discovery well was brought in on the ranch of S. L. Fowler, who had been threatening to sell out for many years, but was prevented from doing so only by the advice of his wife. The test was financed from a pool of $100-contributions from neighbors who hired a drilling contractor. In brief, the discovery came in for 1600 bbl. at a shallow depth. Almost overnight the drilling orgy was on and one of the major Texas oil booms was making history. The townsite orgy of development has been unparalleled in Texas oil history. By August of the following year, this field was producing 120,000 bbl. of oil per day. Wells were promoted by stock-raising on a far-flung scale.

Electra. The first commercial discovery in North Texas was in 1911 on the Waggoner famed cattle ranch, embracing some 600,000 acres in Wichita, Wilbarger, Baylor, Archer, Jack, and Clay counties. Back in 1902 W. T. Waggoner ordered a water well drilled to increase the supply of drinking water for his cattle. Only a small flow of oil rewarded the drillers at 2000 feet. At the time, ranchmen on the place used the oil to grease leather and to dip hogs. But development was not under way on the ranch until 1911. Later a blanket lease was given to The Texas Company, the ranch retaining an over-riding royalty. Out of the development rose the famed shallow Electra field, named after Waggoner's daughter. Oil wealth built the skyscraper Waggoner building in Fort Worth, as well as the well-known race course, Arlington Downs, between Dallas and Fort Worth.

Archer County. Still producing faithfully after being "on the pump" for 25 years, Archer County's discovery well sets a record unsurpassed in North Texas. This oil well, known as the Miller well, is still producing five bbl. a day. In fact, besides being the longest-lived producer in that region, it is perhaps the most consistent well thereabouts, having gauged five bbl. every day, for the last 16 years. It is 12 miles south of Archer City, and five miles east of Anarene, on block 1825, T. E. & L. survey.

In addition to its 25th anniversary, the latest development is bringing the locale of the discovery well back into the limelight. Only a few locations west of the Miller discovery, Albright et al recently "spudded in" to offset recent Gunsight saturated lime production to the north. Thus the New meets the Old in the latest wave of oil development that periodically crosses the rocky stretches of this once forsaken oil territory.

Maintaining their faith in Archer County, the same party that "blocked up" the original acreage back in 1908, namely, J. J. Perkins, is largely responsible for the latest development in that county from the Gunsight lime, especially on the Falls County school land that during the past year has lifted its producing position to first place in North Texas. Of course, the success of application of "acidizing"—treating saturated lime with dilute hydrochloric acid—makes this unique position possible. Slightly more than a decade ago the county's production was insignificant. A reassuring angle of the present development is that the

Gunsight is less spotty than the underlying Swastika sand, the producing horizon of the discovery well, and a more or less "sheet" sand throughout the county. So spotty is the Swastika sand that had the original location for the Miller well been made a location west, south, or southeast, a "dry hole" would have resulted as future drilling proved, and southern Archer County would have been condemned as entirely oil-barren.

Canyon Lime Pay. One of the most profitable deeper productive horizons discovered in the North Texas district is the Canyon lime production found in the center of the original Chalk Hill pool in northern Archer County from 2190 ft. to 2240 feet. To date, 17 producers have been completed in this deep pay, 13 of which flow naturally. Deep Oil Development Co.'s No. 2 McCrory-Wilson lease 4-A flowed 31 bbl. per hour from 2206-19 ft. during 1935.

The first Strawn production (Upper Pennsylvania) to be found in Archer County was obtained in April, 1932, by the Deep Oil Development Company at their No. 1 L. F. Wilson on Lease 5A, which was completed from pay found at 3614 ft. to 3638 ft., 1400 ft. below the base of the Canyon lime pay. This test had been drilled originally to 5750 feet.

Childress County. Four miles southeast of Kirkland, a new Canyon lime pool was indicated in July of 1935 at Alma Oil Company's No. 1 Mollie Low, which swabbed 40-gravity oil from a depth of 5,653 ft., after plugging back from Ordovician levels. It was 30 miles northeast of the Johnson pool, on the Foard-Cottle County line. The discovery was in section 4-17, W. & N. W. survey in Childress County. Resultant lease activity extended into Hardeman County.

Young County. The most productive well in the North Texas district is reported as Sinclair Oil and Gas Company's (now Sinclair Prairie Oil Company) No. 1 Moran. Cumulative production has been in excess of 1,075,000 bbl. of pipe line oil.

Young County is the locale of perhaps the shallowest and also the deepest production in the district, production having been found as shallow as 300 ft. in the north end of the county and as deep as 4800 ft. in the Bend lime in the east-central portion of the county.

Texaco-Burns. One of the deepest discoveries, geologically speaking, in the North Texas district is commercial oil production in the Bend Lime in east-central Young County. The discovery well was The Texas Company's No. 1 E. L. Burns, completed in August, 1932, from 4111 ft. to 4122 ft. for an initial production of 45 bbl. of oil per day. Production soon settled to 24 bbl. per day, without a trace of water.

A typical columnar section for this locality is shown from this log:

Gunsight Lime	155 to 163 ft.
Palo Pinto Lime	1480 to 1730 ft.
Caddo Lime	4067 to 4098 ft.
Bend Lime	top 4098 ft.

Deep Production in Wichita County. Production in the Strawn sand (Upper Pennsylvania) was found in June, 1931, in Wichita County at the Deep Oil Development Company's No. 1 Munger, which made an initial production of 100 bbl. per day on the pump from a depth of approximately 3700 feet. Two years later this well was producing 85 bbl. per day. The north offset, the Deep Oil Development Company's No. 1 First National Company, made 125 bbl. per day on the pump from 3693 ft to 3911 ft., after plugging back from 3960 feet.

Cooke County Flank Discoveries. Cooke County, which had remained dormant since 1930, was revived in 1936 when Burk Royalty Company completed their No. 1 Talbott, six miles southeast of Gainesville as a 60-bbl. pumper from a total depth of 1655 feet. A deeper sand was found in March of the same year. The discovery was of a flank pay in the Upper Pennsylvanian, jutting out against the Muenster arch. Activity was participated in by operators from Fort Worth, Wichita Falls, Dallas, and Houston, Texas, and Ardmore, Oklahoma City, Tulsa, Oklahoma.

The most recent flank sand discovery was made on April 24, 1936, by Anderson-Kerr Drilling Company, Oklahoma City, at their No. 1 Bruhlmeyer two miles east of Gainesville.

Map showing oil fields of North Texas district

WHY WE'RE CROWING

WHEREVER you go in the oil country, production men are talking about the superior performance of "Oilwell" Sucker Rods.

The reason is that no one but "Oilwell" can produce these out-performing, fully heat-treated rods . . . rods that are laboratory controlled from our ore mines to your own wells . . . rods that are processed in furnaces and auxiliary equipment found only in "Oilwell's" plant.

With these exclusive facilities "Oilwell" produces the several grades of rods needed to handle every well condition. Each grade has the most desirable combination of physical properties for its job—properly balancing strength, toughness, resistance to corrosion and fatigue — with uniform quality throughout its entire length.

Grade "S" Rods are the talk of the lease in sulphide and corrosive areas. They resist corrosion and fatigue better than any others.

Metallurgically trained engineers can help you select the best grade of rods for your purposes just as they have in hundreds of other cases.

Why shouldn't we crow? "Oilwell" Sucker Rods and Pull Rods are driving rapidly ahead —even though we are sometimes hard pressed to keep up with customers' delivery requirements.

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United States Steel USS *Corporation Subsidiary*

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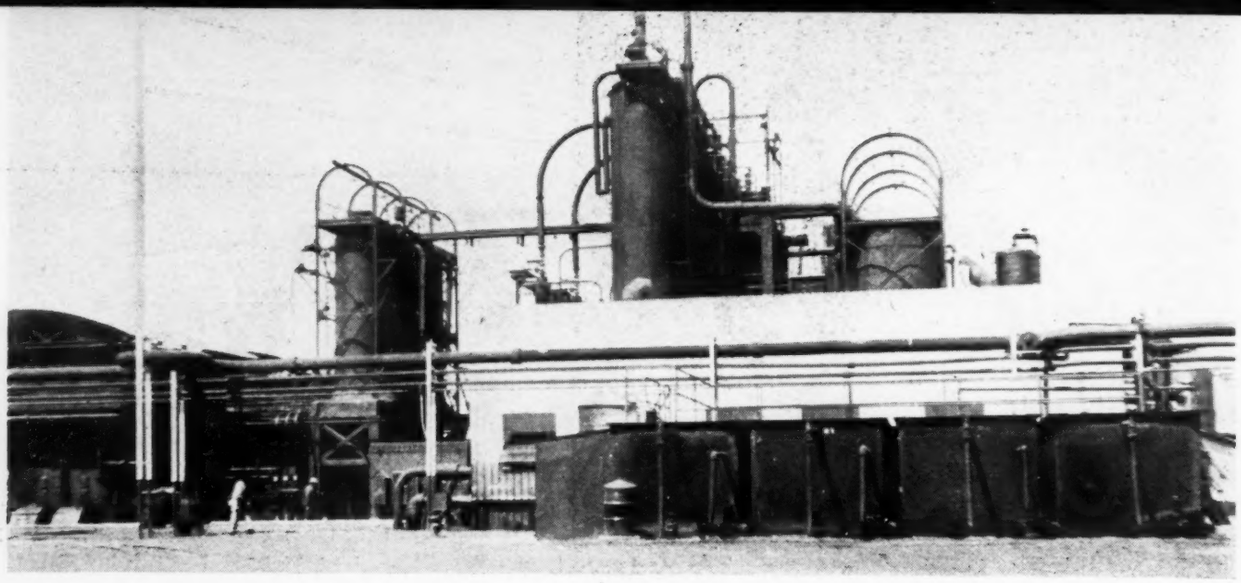


Continental Oil Company's refinery at Wichita Falls in North Texas

It was completed for 331 bbl. of oil per day from a depth of 2008 feet.

PRODUCTION METHODS

Acid Treatment. To increase production from old wells in porous, saturated lime, to increase initial output from new producers, and to maintain the flowing life of wells, acid treatment has been used with phenomenal success in the North Texas district where the practice has become general since the spring of 1933.

Adoption of acidizing practice has been responsible for raising Archer County from a minor production position to premier position in North Texas by 1935. A saturated zone found in the Gunsight lime at 600 ft. in the southeast corner of the county to 3900 ft. in the northwestern portion, has yielded increases as high as 4500 percent. Especially was the treatment successful in wells on the Falls County School Land fee where the Continental Oil Company and W. B. Hamilton were leaders in the development. Treating with acid was regular practice upon completion.

This method of increasing production was used to great advantage in Wilbarger County on the Waggoner ranch in the Landreth lime, which has a saturated thickness of from 15 ft. to 18 feet.

Acidizing involves the use of 500 to 6000 gal. of acid, either in a single treatment or in stages, the minimum reaction time being four hours. A load consisting of 100 bbl. of crude oil under 50 lb. pressure is maintained on the well during treatment and following the placement of the acid.

Repressuring. Repressuring to increase production was experimented with in 1933 by the Humble Oil and Refining Company at Olney in northern Young County. An experimental plant was installed for the purpose.

Cook Pool Repressuring Plant. One of the shallowest repressuring projects in the state of Texas has been in operation since 1928 in the Cook pool of Shackelford County, 14 miles northwest of Albany. There are more that 300 wells in this field, which has been developed under a single fee ownership (I. W. Cook Estate), and joint partnership of Roeser and Pendleton,' Inc., the discovery operator, and the Marland Oil Company and later the Continental Oil Company. A portion of the gas requirements is purchased from the Lone Star Gas Company for the operation of the plant.

REFINING

Effect of "Hot Oil" on North Texas Markets. Invasion of the natural markets in the North Texas district by the low-priced products originating in the East Texas field (particularly by gasoline refined from "hot oil" purchased at one-third to one-half the regular posted price), prompted Waggoner Refining Company to withdraw from the crude purchasing market in Wichita and Wilbarger counties on September 1, 1934. This company's refinery near Electra was unable to operate at a profit due to prevailing low wholesale gasoline prices. The Waggoner Refining Company is owned by the W. T. Waggoner Estate.

Young County. An 800-bbl. topping plant has been in operation at Olney in northern Young County to process crude from leases in that vicinity. It is owned by the Norgold Refining Company. Small independent plants are owned by the Danciger Refineries, Inc., in southeast Cooke County, by the Mid-Tex interests at Eliasville in southeastern Young County, and by the Moon Refining Company at Graham in Young County.

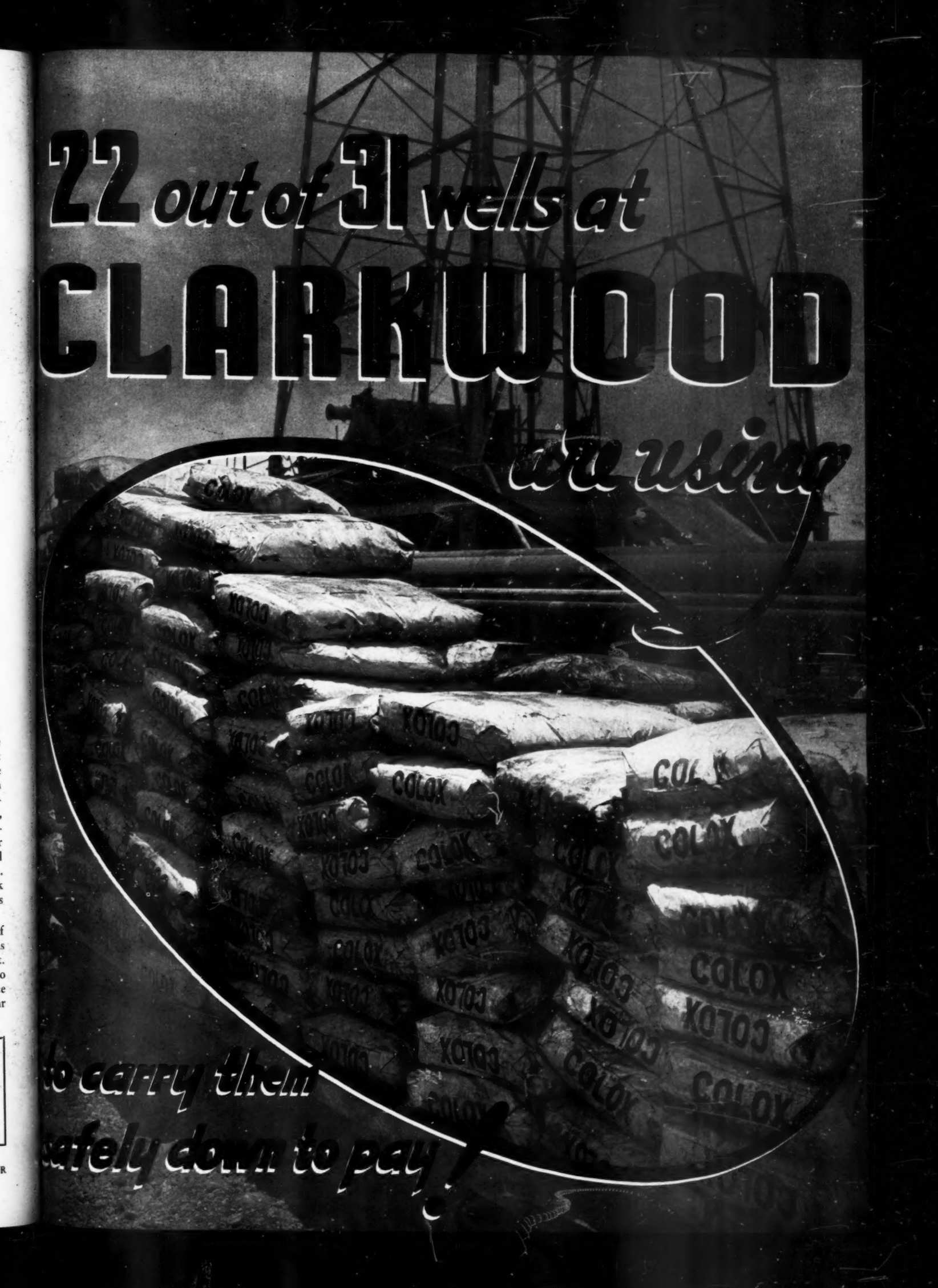
PIPE LINES

The accompanying table is a summary of pipe lines in operation serving the North Texas district, including Archer, Clay, Baylor, North Young, Wilbarger, Wichita, Montague, Cooke, and Jack counties.

The Stanolind Pipe Line Company's system in North Texas serves Foard, Wilbarger, Wichita, Cooke, Montague, and Jack counties. A 4-in. feeder line serves the Muenster and Bulcher lime pools of Cooke County, connecting at Nocona in Montague County with the 8-in. trunk line leading to Graford in Palo Pinto County via Bowie. Northbound shipments originate in Foard, Wilbarger, and Wichita counties serving the Vernon pool in Wilbarger County, and the K. M. A., Electra, and Burkburnett pools in Wichita County. From the Graford station the trunk line extends southeastward to Harris County on the Gulf Coast.

The pipe line facilities of the Gulf Pipe Line Company in North Texas originate at Electra and Burkburnett. The trunk line extends southeast to Fort Worth and Weatherford thence to the Gulf Coast via Lufkin and Sour Lake.

Pipe Line Company	Point of Origin	Point of Destination	Size	Length
Gulf Pipe Line Co.	Trunk Line	Chalk Hill, Archer	2 in.	3500 ft.
Danciger Oil & Ref.	Pilot Pt. Pool	Loading Rack	4 in.	3 miles
Panhandle Ref. Co.	S. E. Young Co.	Loading Rack	2 in.	3 miles
Nortex Pipe Line Co.	Buttram Pool	Bryson, Jack Co.	2 in.	8 miles
Brazos River Gas Co.	S. W. Jack Co.	Bryson, Jack Co.	2 in.	8 miles
Olney Oil & Ref. Co.	Olney Ref.	Newcastle Pool	4 in.	3.5 miles
Upham Gas Co.	S. E. Young Co.	Upham Main Line	2 in.	8 miles


22 out of 31 wells at
CLARKWOOD
are using
COLOX
XOTOX
to carry them
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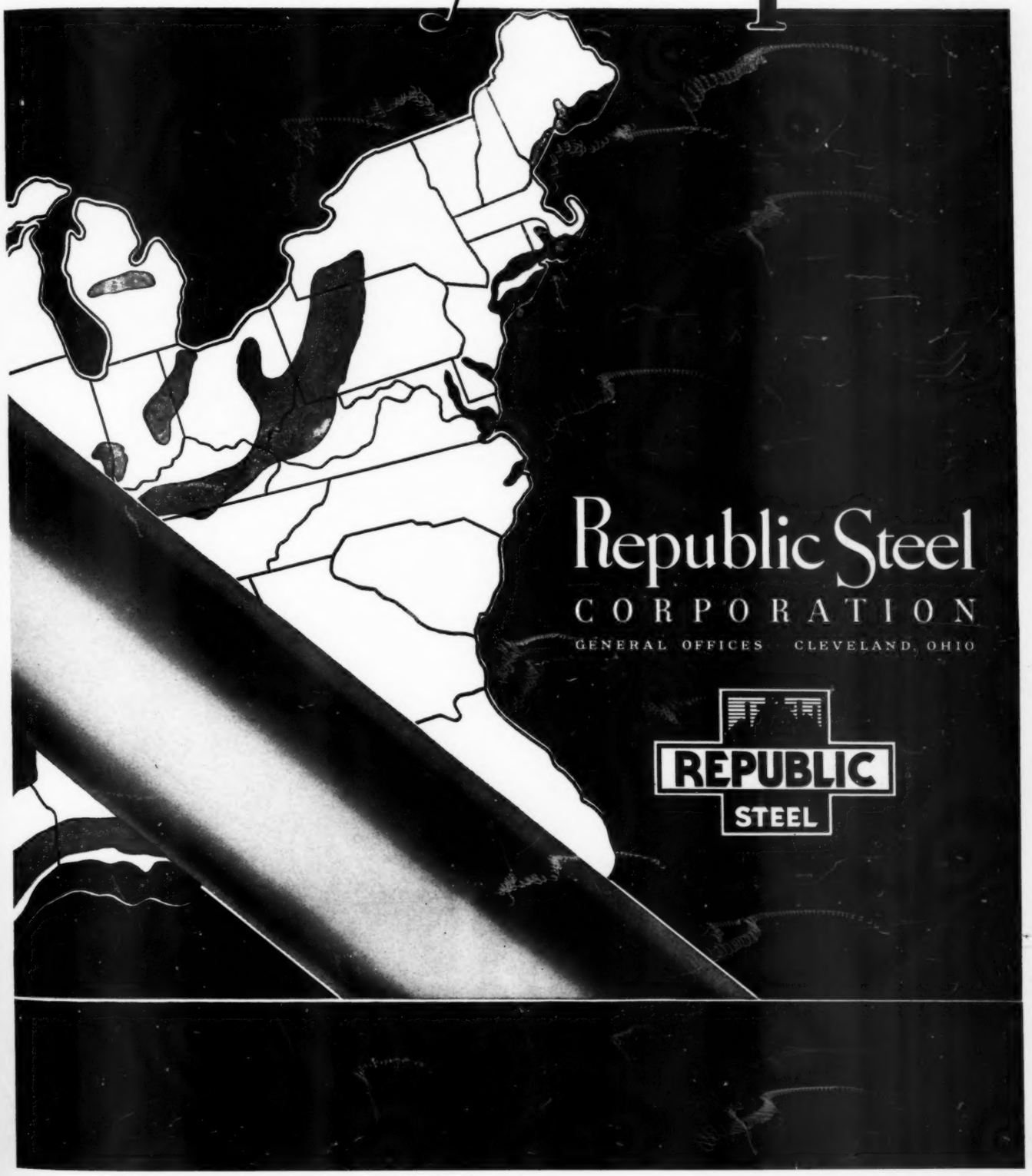

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FIELDS THROUGHOUT THE WORLD
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"MORE WELLS
PER STRING"

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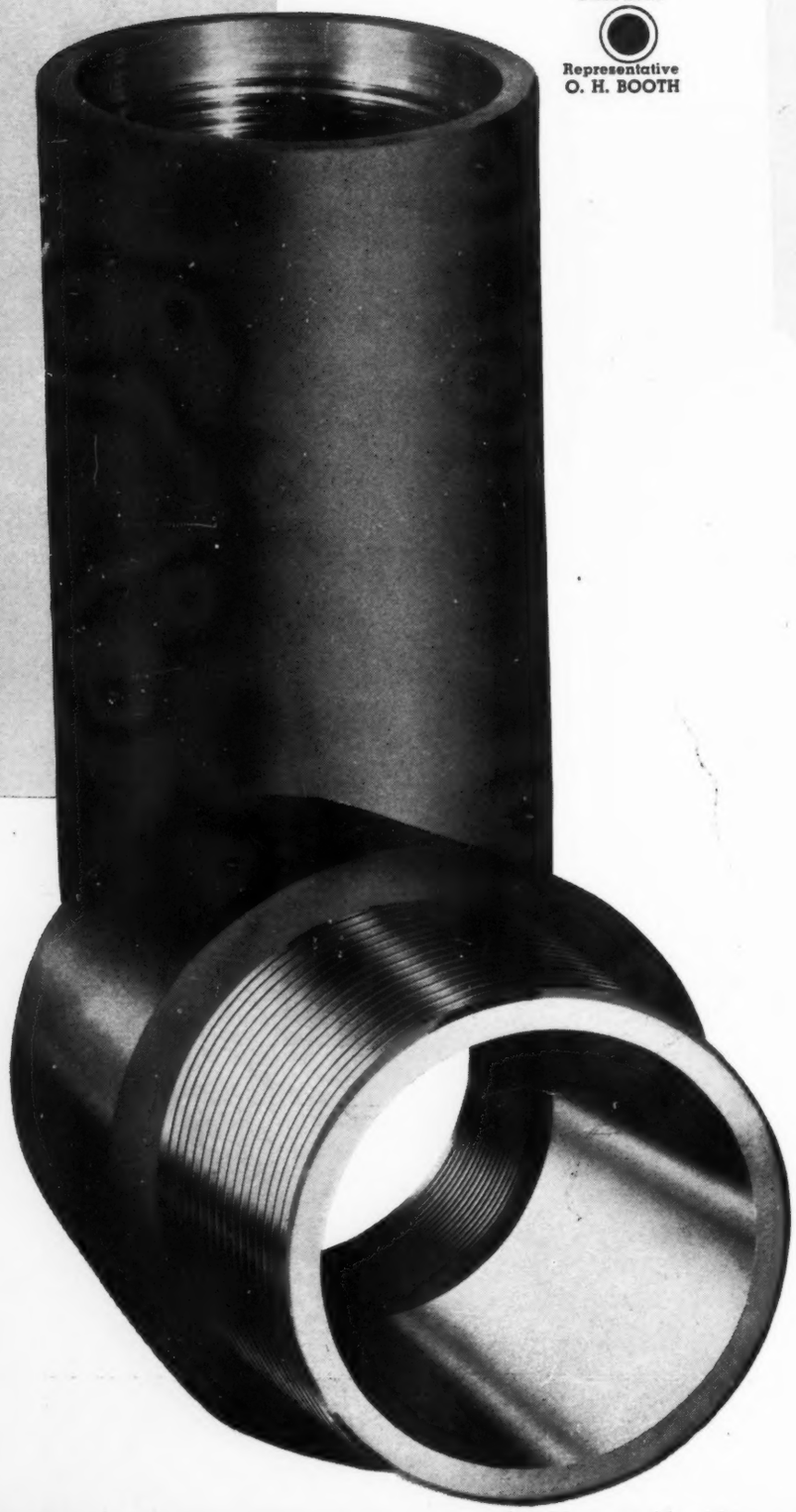
O. H. BOOTH

ARDMORE, OKLA.
Representative
JOHN KLEP

WICHITA FALLS
Representative
E. H. SHAW

DALLAS
Representative
WILL I. (Bill) LEWIS



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Review of Petroleum Development in Texas Panhandle

DRILLING AND PRODUCTION

Introduction. The Panhandle oil and gas field is by far the largest gas field in the world and its oil-producing area extends in spots along a 100-mile front. More than 245,000,000 bbl. of oil has been produced from 3250 wells. The entire region embraces more than 1750 square miles, comprising portions of Hutchinson, Moore, Carson, Gray, Wheeler, Roberts, and Potter counties. During the past ten years stupendous volume of three and one-half trillion cu. ft. of gas has been withdrawn from this reservoir. The production is affected by a series of faults in echelon trending northwest to southeast. Four hundred million cu. ft. of gas is carried daily by nine interstate pipe lines to metropolitan points in Missouri, Colorado, Illinois, and Texas. A half-billion cu. ft. of gas is burned daily by the 29 carbon black plants in operation.

The total capacity of the 49 natural gasoline plants is in excess of two and one-fourth billion cu. ft. per day, although only 34 are in operation. Panhandle Texas celebrated the 15th anniversary of the discovery of oil in that sector in May of this year. The first oil discovery was in May, 1921, when a commercial well was completed in Carson County. Some spectacular wells have been completed in this district; one, the Skelly Oil Company's No. 6 Saunders in Gray County, had a daily output as high as 6,504 barrels. The magnetometer has been used with great success in Gray and adjoining counties to develop the productive granite wash.

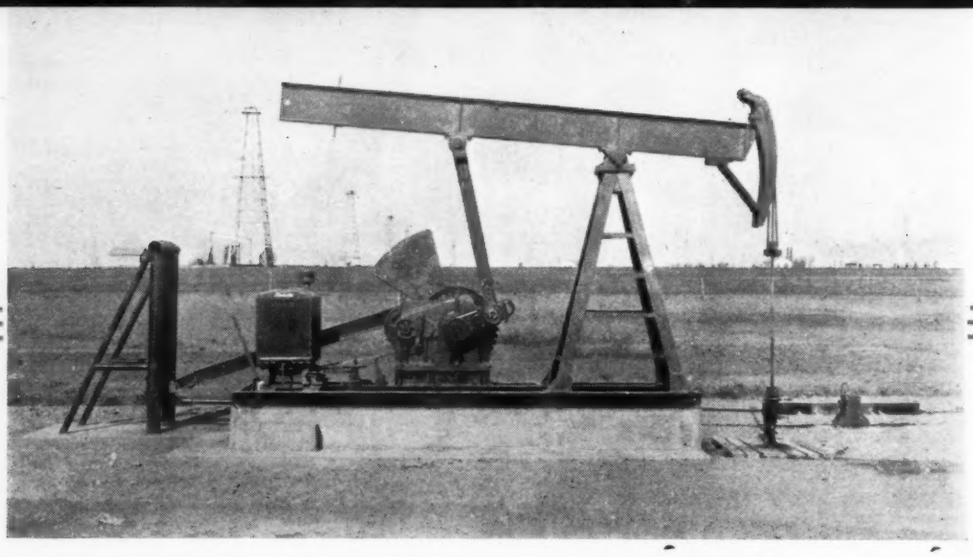
Spectacular Producers. The outstanding producer in the Panhandle with regard to cumulative production is The Texas Company's No. 1 J. B. Bowers in the Pampa district of Gray County, which to date has produced more than 1,600,000 bbl. from the granite wash. Its initial production was at the rate of 1500 bbl. of oil per day from 2845 ft. to 2852 ft. and from 2858 ft. to 2861 ft. in the granite wash pay on original completion on January 9, 1928. Upon being deepened the following week to a depth of 2895 ft., the daily output was boosted to 4500 bbl. per day.

The second largest producer (in cumulative output) was Dixon Creek Oil Company's No. 1 H. E. Smith in the Borger district of Hutchinson County, which has produced more than 1,255,000 bbl. to date. Originally completed on March 28, 1925, for 200 bbl. of 35-gravity crude per day from 2947 ft. to 2960 ft. in the lime pay, its daily rate of production by July, 1933, had dropped to two bbl. per day. This well is in section 14, Morris & Cummings Survey, Block "Y."

Ranking third in cumulative production is McElroy Oil Company's No. 2 E. Cockrell in eastern Hutchinson County. This well had produced 1,045,000 bbl. of crude up to October 1, 1932, and was originally completed on May 1, 1927, when it was brought in for 650 bbl. of 41-gravity oil per hour from pay found from 2922 ft. to 2925 feet. It is in Section 4, Block B-3, D. & S. E. survey, near the Gray County line.

Spectacular Gassers. The largest gas well ever completed in the Panhandle gas field was brought in April 2, 1936, in Moore County by the Phillips Petroleum Company. Their No. 1-66 Moore in section 166, Block 3-T, T. & N. O. survey, had an initial production of 192,000,000 cu. ft. of gas per day from a total depth of 3270 ft. after topping the gas sand at 3005 feet. So large was this volume that it would have been adequate to supply the requirements (for a short time) of the largest gas pipe line in that field. In the same county, Anderson & Kerr, Oklahoma City, completed a 108,671,000-cu. ft. gas well the same week from a gas sand the top of which was found at 2507 feet.

Borger. Oil transformed overnight



Pumping unit with wheel-type counterbalanced back-crank and gasoline engine. A pumping pendulum and regular knock-off post are used for pumping second well. Phillips lease of British American Oil Producing Co., near Pampa

a Texas desert into an oasis that still flourishes. Only 11 years ago, when oil and gas were found in Hutchinson County in the wind-swept Panhandle stretches, that county's population numbered only 31. What a contrast to the result of the ensuing oil boom that made Borger perhaps the West's wildest oil town. Borger was under martial law for 23 days in 1929 when 97 cavalrymen carried out the order of the Governor's proclamation.

In one day, $100,000 worth of town-lots was converted out of what had been 240 acres of barren prairie land. The six-shooter had a hectic reign before the Texas Rangers were called out to restore law and order. But the Borger of today is a respectable, prosperous, thriving city. Oil accomplishes strange transformations.

Deepest Test in Panhandle. The deepest test ever put down in the Panhandle of Texas was abandoned on November 27, 1934, in northeastern Moore County. It was the Phillips Petroleum Company's No. 2 Wilson in section 157, block 3, of the T. & N. O. survey. This test was plugged at 8012 ft., after it had been drilled to the Ordovician horizons.

Proof that the Ordovician formations exist in Panhandle Texas was obtained from paleontological data derived at Phillips Petroleum Company's No. 12 Whittenburg in the Tumlinson survey, in section 3 on the Elva lease in Hutchinson County. This well entered the Viola (Fremont) at 4810, the Simpson (Hardin) at 4875 ft. and the Arbuckle or Ellenburger (Manitou) at 5100 feet.

Believing that the Ordovician was folded on the north flank of the Panhandle uplift, Phillips Petroleum Company started an Ordovician test in February, 1936, in Wheeler County, northeast of the old Kellerville field. Its location was in section 35, block A-8 H. & G. N. R. R. survey in the G. W. Porter ranch.

NATURAL GASOLINE

The largest natural gasoline manufacturing district in the United States is in the Panhandle oil and gas field. The 49 plants installed there have a total daily capacity of two and one-quarter billion cu. ft. per day, although only 33 plants now are in operation.

The natural gasoline output from 1930 to 1934 was as follows:

1930	315,000,000 gal.
1931	352,000,000 gal.
1932	155,125,000 gal.
1933	178,900,000 gal.
1934	246,000,000 gal.

In this district the leading manufacturer of natural gasoline is the Phillips Petroleum Company, with operating headquarters at Borger; Skelly Oil Company ranks second, with headquarters at Skellytown, on the Schaefer ranch.

NATURAL GAS PIPE LINES

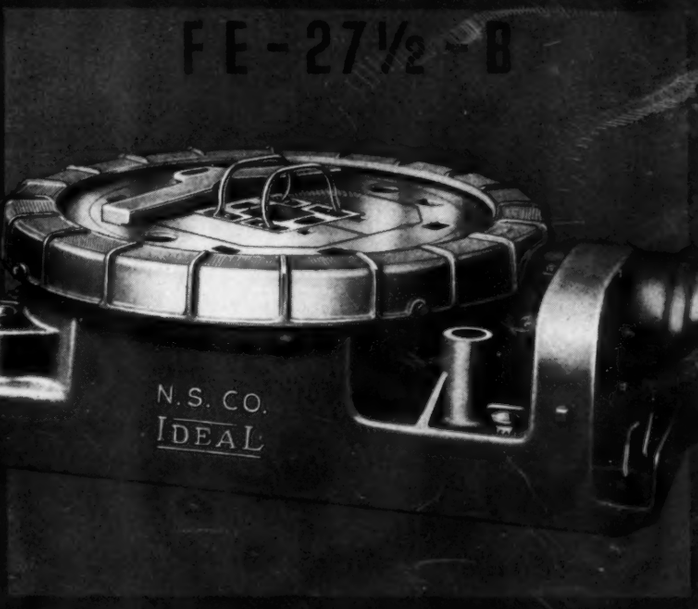
Natural Gas Lines. The accompanying table is a thorough summary of the natural gas pipe lines emanating from the Texas Panhandle.

A central power in Gray County, Texas

IDEAL

"Reg. U. S. Pat. Off."

ROTARY MACHINE



An extra heavy, fully enclosed unit type Rotary that meets the requirements of deep well drilling of any field . . . Modern design and construction have been combined in this unit to produce an extremely smooth and true running machine which is safe, fast and economical.

THE NATIONAL SUPPLY COMPANY

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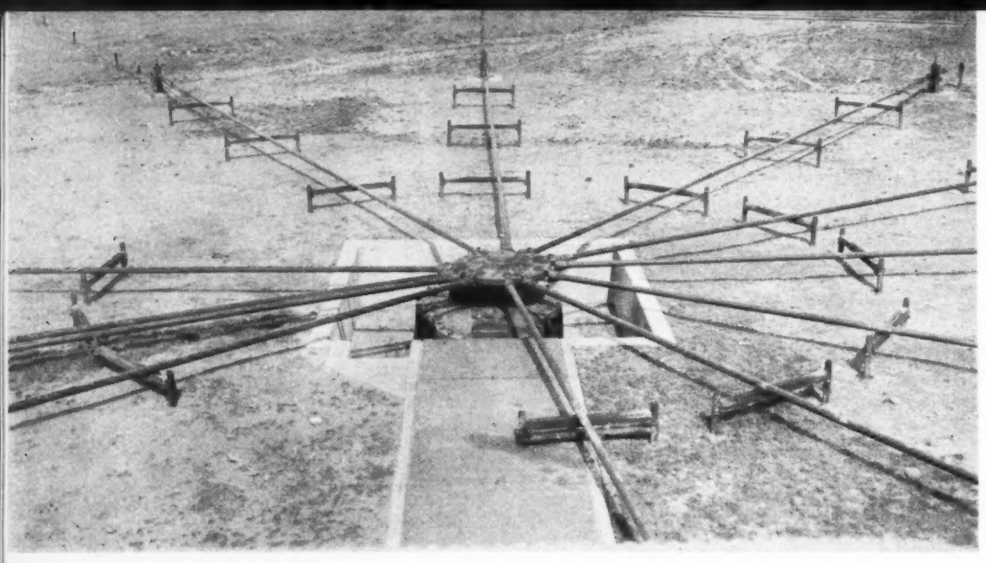

Central power pumping group of wells in Panhandle district

Ten lines, ranging from 14 in. to 24 in. in diameter, serve such metropolitan centers as Denver, Minneapolis, Chicago and Indianapolis.

GASOLINE PIPE LINE

One of the largest gasoline pipe lines in the nation is that of the Phillips Pipe Line Company, a subsidiary of the Phillips Petroleum Company, extending from Borger in Panhandle Texas northeastward to East St. Louis, Illinois, a distance of 680.7 miles. A 53.5-mile 6-in. branch line extends from Paola, Kansas to the Phillips refinery at Kansas City, Kansas. It is comprised of 8⅝-in. 24.696-lb. electric-welded pipe. The system is operated in four distinct sections, the gasoline entering the line at Borger, Eldorado, and Paola: (1) Borger to Wichita, (2) Wichita to Paola, (3) Paola to East St. Louis, and (4) Paola to Kansas City. The key pump station at Borger comprises three units totaling 795 hp. Another key station at Spearman, has two units totaling 600 hp. A booster station at Stinnett, has one unit of 100 hp., and another at Darrouzett comprising one 250-hp. unit. There are 17 other pump stations in Oklahoma, Kansas, and Missouri along the route of the line. The terminal storage in Texas comprises eight tanks, all situated at the Borger terminal. Five of these are of the floating roof type, comprising one 3800-bbl. tank, two 55,000-bbl. tanks, and two 80,000-bbl. tanks, and are used to store 12-lb natural and refinery gasoline. Three Horton Spheroid tanks of 20,000-bbl capacity also form a part of the Borger terminal facilities, and are used to store 26-lb. natural gasoline. Butane, as well as natural gas, is used to fuel the centrifugal pumps at the stations. At the line stations the pumps are driven by slow-speed gas engines through gear increasers.

Pipe Line Company	Point of Origin	Point of Destination	Size of Line
Panhandle-Eastern	Moore Co.	Indianapolis	24-in.
Natural Gas Corp. Am.	Hutchinson	Chicago, Ill.	24-in.
Northern Gas and Pipe Line	Carson Co.	Minneapolis	24-in.
Empire Gas and Fuel Company	Gray Co.	Kansas City	20-in.
North Texas Utilities	Wheeler	Canadian	
Consolidated Gas Company	Wheeler	Enid, Okla.	14-in.
United Gas Company	Wheeler	Wichita Falls	14-in.
Lone Star Gas Company	Wheeler	Dallas, Texas	16-in.
South Plains Gas Company	Hutchinson	Midland; Clovis	16-in.
Canadian River Gas Company	Moore Co.	Denver, Colo.	22-in.

Index to Oil and Gas Pools of Texas Panhandle

HUTCHINSON COUNTY: 1. Borger, 2. Dial, 3. Stinnett, 4. Yake, 5. Merchant, 6. Sanford, 7. Bivins, 8. Trigg, 9. Margaret Johnson, 10. Moore-Watkins, Cooper, 11. McIlroy. MOORE COUNTY: 12. Sunray, 13. Morton, 14. Coffee, 15. Brumely, 16. Armstrong. CARSON COUNTY: 17. Roxana, 18. Noel-Schafer, 19. West Jordan, 20. Lewis, 21. Jordan, 22. Fields, 23. Burnett. GRAY COUNTY: 24. West Pampa, 25. Short, 26. Williams-David, 27. South Pampa, 28. Bowers, 29. Palmer-Combs Worley, 30. Eustis. WHEELER COUNTY: 38. D'Spain, 40. Bently, 41. Comprary, 42. Mankins, 43. Triangel wells, and 44. Koons.

Cameron
TYPE SDA RAMS,
closed on oil-string collar,
HELD **500 LBS.** PRESSURE

An unusual and convincing demonstration of the *self-feeding* principle of Cameron ram packing elements occurred very recently in the Corpus Christi area.

A drilling contractor landed and cemented his 7-inch oil string. The 7-inch casing rams of his 13⅜-inch Cameron Type SDA Blowout Preventer were then closed around the pipe in order to pump a cement "collar" between the 13⅜-inch surface pipe and the 7-inch oil string, cement passing through the Braden Head casing outlet. Circulation was broken at approximately 500 pounds pump pressure and the cement "collar" pumped in.

After allowing the required time for cement to set, the blowout preventer was removed, and it was discovered that the preventer *rams had been closed around a collar of the 7-inch casing instead of the pipe.* Notwithstanding the fact that the rams were designed to close and seal around the pipe only, the *self-feeding* principle of the Cameron ram packing elements forced out enough rubber packing to make a leak-proof seal around the collar, and hold 500 pounds pressure.

Pleased with the performance of his Type SDA Blowout Preventer, the contractor made us a present of the pipe collar as a "keepsake." An un-retouched picture of this collar is shown above. Grooves cut in the collar by the packing retainer plates are clearly shown, and indicate the tremendous closing power developed by the Pressure Operated Type SDA Blowout Preventer.

This incident proves, beyond doubt, that the new *self-feeding* ram packing with which all Cameron Type SDA Preventers are equipped, actually does "feed out" to the pipe—even under conditions it was not designed to cope with.

Operators considering the purchase of new blowout preventer equipment will find, on investigation, 32 outstanding reasons why Cameron Type SDA Pressure Operated Blowout Preventers offer the greatest safety, the greatest control and the greatest value. Full details and information will be furnished promptly on request.

One-piece Cameron self-feeding ram packing element which mechanically feeds packing out to the pipe to be sealed. Each element contains from 3½ to 14 cubic inches of packing in reserve, depending upon size of the preventer.

Cameron self-centering ram, which automatically centers pipe in the hole as rams close. Packing element easily and quickly installed in the field by drilling crew when necessary to renew.

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• Metallurgically sound welds are assured by Multi-Flame Lindewelding. Each Lindeweld is strong, ductile, corrosion-resistant and free from defect.

THE Lindewelding process was introduced a little over five years ago. During this time, it has won the acceptance of leading pipe line companies and contractors as the standard method of joining pipe.

More than 5,000 miles of pipe lines have been Lindewelded. On each line Lindewelding has contributed dependability, speed, and low construction cost.

Lindewelding is Dependable

This is reflected in the records of many projects of which the following are typical:

On one important project many miles of lines—6-in. to 14-in. in diameter—for gas, oil and water were Lindewelded. Upon completion the lines were tested under 200-lb. water pressure. Every Lindeweld was leakproof and has remained so.

On an 80-mile piping system for a gasoline plant, Lindewelding was used after careful tests had proved that this method produces dependably uniform results. costs less, and could be done in less time. The completed system was tested under pressure and the company's engineers reported "Not a single defective weld."

Lindewelding Saves Time

On a 42-mile line of 10-in. diameter pipe, Lindewelding effected a 25 per cent saving in welding time over older methods.

On a line of 6-in. pipe, a record of 89 welds per man-day was achieved by men with little previous experience with Lindewelding. Formerly 60 welds a day had been a good average.

On another line, ten miles of 8-in. pipe were Lindewelded in three days. A six-man crew averaged 304.6 welds a day—a 50 per cent increase over the average previously established on 14 miles of the same line.

The Lindeweld is Tough

Recently a bend test was made on a 60-ft. section of Lindewelded 6-in. pipe. With the section securely blocked so the two Lindewelds would get the greatest stress, a tractor bent the cold pipe through a half circle. Neither of the Lindewelds cracked, collapsed or buckled.

Uniform Results

Lindewelding has, as its first requirement, the uniform production of welds fully as strong and as ductile as the pipe itself. This new technique at the same time doubles or triples the daily production of sound welded joints. It saves 15 to 40 per cent in oxygen, acetylene and welding rod and often as much as 50 per cent in time.

The multi-flame head for Lindewelding further improves these results. Multi-Flame Lindewelding will produce consistently full-strength welds in pipe base-material even where extra high-strength pipe up to 110,000 lb. per sq. in. in tensile strength is used.

20,000 Miles of Pipe Line Welding Experience

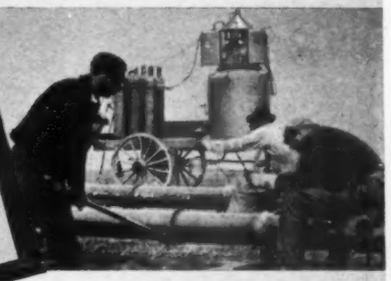
Multi-Flame Lindewelding is a result of the closely coordinated laboratory development, and field engineering facilities of the Linde organization, which has fostered the progress of oxy-acetylene welding and cutting in pipe line construction since its first use on an overland pipe line in 1911. This organization, because of long experi-

LINDEWELDING
for Pipe Line Construction

• Pipe line of 20-in. diameter for public gas service being Multi-Flame Lindewelded.

• Not a leak developed in any Lindeweld in this gasoline line when a flood washed it fifteen feet down stream.

• Multi-Flame Lindewelding a pipe line 8-in. in diameter to carry gas.



• Oxweld Type MP-4 Acetylene Generator supplies acetylene for Multi-Flame Lindewelding on 143-mile 8-in. oil pipe line.

ence in the pipe line field, is well qualified to assist you in organizing welding operations to secure the greater strength, ductility and economy now obtainable with this new process. Linde Process Service has been identified with the welding of more than 20,000 miles of pipe in the oil fields alone. Why not have Linde work with you on your next pipe line project?

Multi-Flame Lindewelding Movie

A motion picture, "Multi-Flame Lindewelding," has been produced to show the multi-flame blowpipe head in operation, and to demonstrate the correct technique for its use. Ask the Linde Office nearest you to arrange a showing of this motion picture before members of your organization. This will not obligate you.

Left: Section from motion picture film showing the three flames from the blowpipe over the area of molten metal in the weld.

UCC

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How to secure GREATER OIL RECOVERY

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Bulletin Number 36

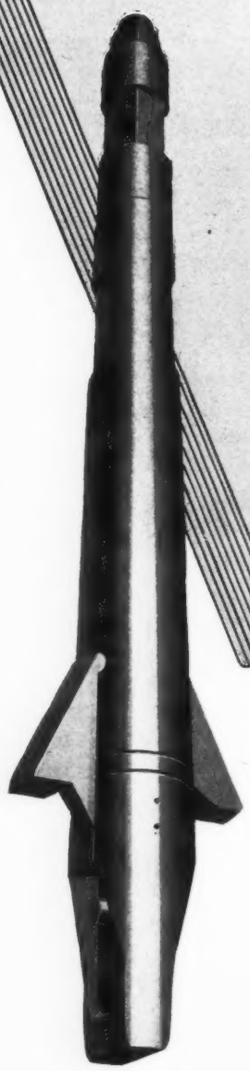
The Roe "Pay" Underdigger, a patented cable tool manufactured and distributed exclusively by the Bridgeport Machine Company, is used extensively by major producing companies and independent operators to increase oil and gas production in both old and new wells of any depth, and is used with equal success in either rotary or cable tool drilled holes, where the production comes from either "lime," "shale" or "sand" formations.

Old wells which have practically ceased to produce have been reconditioned by underdigging, in many instances the gas as well as the oil production having been materially increased.

New wells have been brought in more quickly. at less cost and with greater initial production by removing plastered mud, cement and other obstructions from the face of the "pay" formation with the Roe "Pay" Underdigger.

In preparing the hole for acidization, or for a "shot"; for reconditioning the hole after a "shot"; and for preparing the hole for pipe cementing, the Roe "Pay" Underdigger is effective, economical and simple to use.

These uses for the tool are clearly explained in Bulletin No. 36.



Send for your FREE copy

This new booklet, which we will be glad to mail free of cost or obligation to anyone actively engaged in the oil business, explains in detail how old production may be brought back by cleaning the walls of the hole through the producing zone; how new wells may be helped by enlarging the hole through the pay formation; and how the Roe "Pay" Underdigger is used to overcome many of the problems encountered in well drilling.

It explains the mechanical details of the tool; how it operates; contains authentic data on results obtained by underdigging; sales and rental prices for the various sizes of Underdiggers; and other information of value to those owning or operating producing properties.

To secure a copy write for Bulletin 36, or secure your copy from our nearest representative.

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Review of Petroleum Development in Southwest Texas

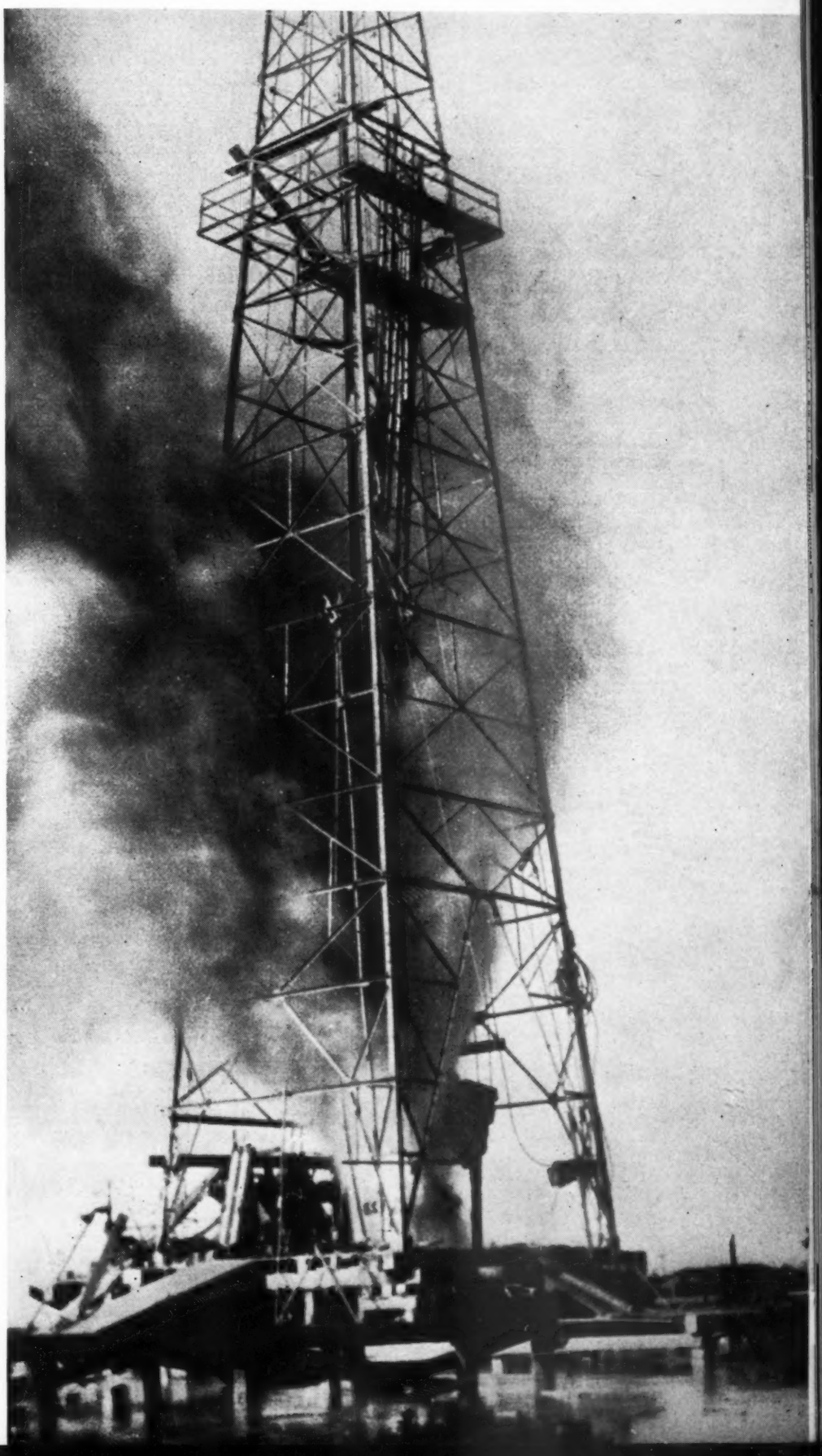
A—REYNOSA ESCARPMENT DISTRICT

DRILLING AND PRODUCTION

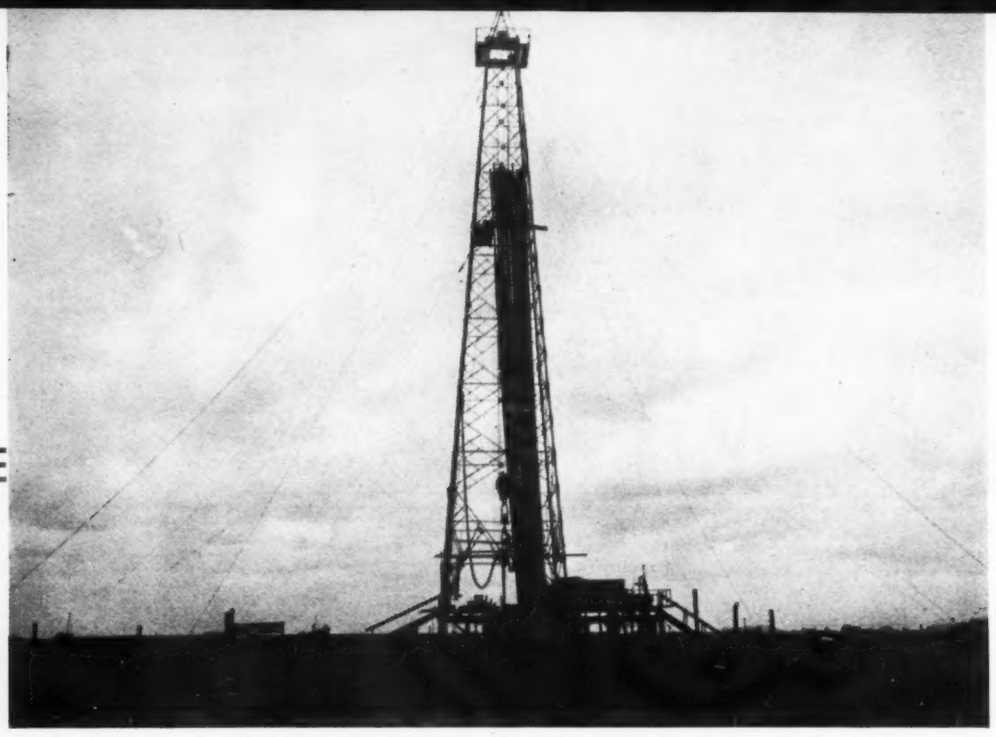
THE Reynosa Escarpment district comprises the Reynosa escarpment and the Oakville escarpment of Pliocene and Miocene age that outcrop across McMullen, Duval, Jim Hogg, Zapata, Webb, Starr, and Hidalgo counties. The escarpments coincide with the northern limits of proven production at Lomo Alto in southern McMullen County from which point it trends southwest to the Government Wells field in northwestern Duval County, where it turns due south along the west line of Duval County, crossing in northeastern Zapata County where it again turns to the southeast at the Cuevitas field in northern Starr County, trending through the Rio Grande City field in that county. The southern limits of proven production is marked by the Sam Fordyce field in southwestern Hidalgo County and eastern Starr County.

Along these escarpments have been developed 44 oil and gas fields with production ranging in depth from 160 ft. to 4900 feet. Producing horizons range in geologic age from as old as the Mount Selman to as young as the Jackson (Fayette), all of Eocene age. Production has been found also in the intervening formations in the Yegua and Cook Mountain. A typical columnar section accompanies this article, giving a list of the producing areas and the age of the principal producing horizon.

Accumulation is principally due to sand lensing with edge line to the west due to the thickening of sediments towards the coast. Faulting has been auxiliary in accumulation but is a factor nevertheless. Total production to the end of 1927 was 14,527,900 bbl., representing a total development of 1700 wells, including non-producing tests.



A gas well in the coastal area of Texas running wild from the Frio sand



Silhouette of a well in the Saxet field, Nueces County

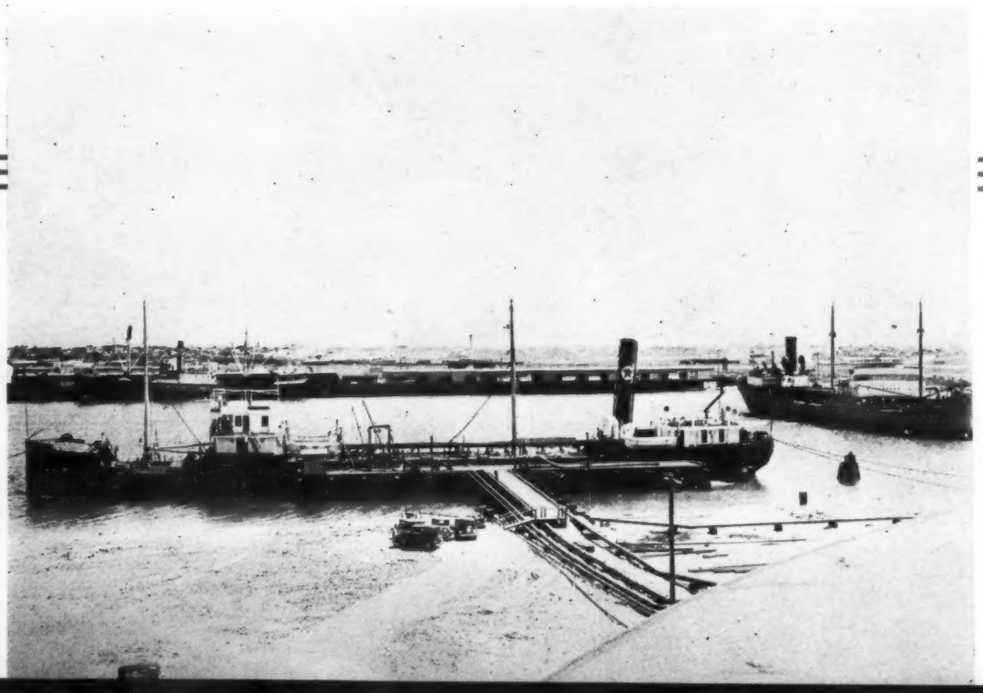
The Government Wells field of northwestern Duval county is the largest producing area in the escarpment, having produced more than 10,000,000 bbl. of oil to date. Two new field developments during 1935, at Seven Sisters and at Lomo Novio, have revived the district. Excellent flush production has been obtained, as great as 60 bbl. per hour per well in the two latter areas from as shallow a depth as 2300 feet.

At present the Reynosa escarpment district has 2500 producing oil wells in the area comprising Jim Hogg, Duval, Webb, Zapata, McMullen, and Starr counties. The district has entered its sixteenth year of production. New producers are being added at the rate of 35 per week on an average. As an example of the longevity of the fields of the escarpment, the Mirando Valley field of Zapata County was opened on April 17, 1921, and is still a producing area.

Charco Redondo Field. One of the shallowest oil fields found along the Reynosa escarpment was the Charco Redondo field of the southeastern portion of the county, opened on the Charco Redondo grant in 1913. The discovery well was the Zapata Oil and Gas Company's No. 1 J. M. Martinez, which came in producing 25 bbl. of 17-gravity oil per day from oil sand topped at 165 feet. Accumulation was due to a sand lens in the Jackson formation, the Reynosa escarpment being one and three-fourths mile west of the field. However, the first outlet for the field was not obtained until December, 1926, when a pipe line was extended to the pool from other areas. A total productive area of 800 acres was developed with a cumulative recovery of 135,000 barrels. More than 315 oil wells have been completed since 1913, but due to the rapid rate of abandonment, the field today is producing little more than ten bbl. daily.

Mirando Valley. One of the longest-lived fields along the escarpment is the Mirando Valley field, opened April 17, 1921, in the northeastern corner of Zapata County by O. W. Killam's No. 3 Hinnant. Initial production was 40 bbl. of 21-gravity oil per day from a depth of 1415-23 feet. By the end of the following year, 18 oilers and one gasser had been completed. Recovery per acre has been as high as 5670 barrels. More than 145 acres have been proven for oil and 205

Marine loading terminal in Corpus Christi Bay



acres for gas. Cumulative recovery has been in excess of 599,000 barrels.

Henne-Winch and Fariss. One of the million-barrel fields along the escarpment is the Henne-Winch and Fariss field of Jim Hogg County. It has produced 3,250,000 bbl. of oil since its discovery on June 23, 1924. The pay sand is in the Jackson series and the accumulation is due to sand lens. To date 700 acres have been proven in oil and 665 acres in gas. One hundred forty oil wells and 35 gas wells have been completed. Recovery has been as high as 7978 bbl. to the acre, although the average is 3919 barrels. The field reached its peak in the fall of 1925.

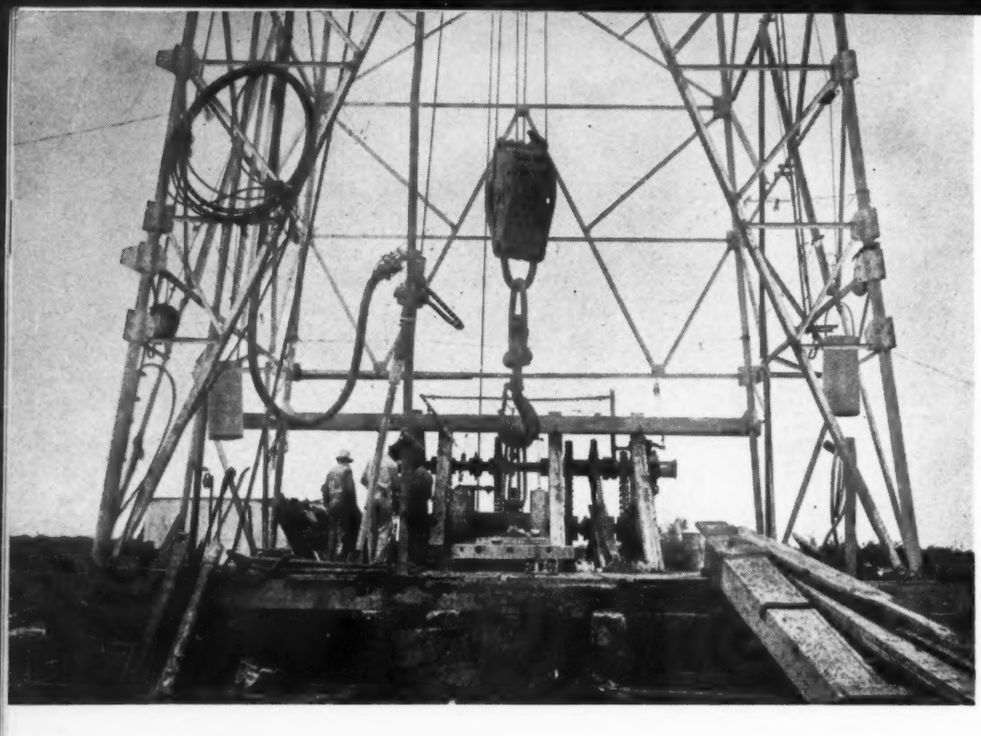
Moca. Of interest is the Moca oil field development in northeastern Webb County and has proved to be one of the shallowest fields on the escarpment. The field was discovered December 16, 1932, by a well 903-909 ft. deep drilled by the Milam Drilling Company on Duval County Ranch Company land. The initial production was 80 bbl. of 21-gravity oil per day from a faulted sand lens, and the field has produced more than 110,000 bbl. of oil from 11 wells. The producing formation is the Cole sand phase of the Jackson series.

HISTORY OF DEVELOPMENT

Reiser. The first commercial production in the Reynosa escarpment area was obtained in 1910 in the vicinity of Reiser, nine miles west of Oilton in eastern Webb County. The discovery well was drilled by the Border Gas Company, a subsidiary of The Texas Company, which subsequently completed 40 gas wells from depths ranging from 150 ft. to 650 ft. in Yegua Cook Mountain, and Mt. Selman formations. Although the discovery was only a five-bbl. well making 25-gravity oil from a depth of 394 ft., it proved that the escarpment was a new oil region for development. The area later was developed into a gas field. Twenty-five hundred acres were developed for gas, and 40 acres for oil.

Jennings. Development of the region lagged until 1914 when the Border Gas Company opened the Jennings gas field 23 miles due south of Aguilares in northern Zapata County, after showings in water wells pointed the way. The discovery gasser, completed on March 19, made 8,000,000 cu. ft. from a total depth of 905 ft. in the Jackson series. Eleven gassers were completed by the Border Gas Company.

Piedras Pintas. Deeper possibilities of the escarpment region were revealed the early part of 1919 by a test drilled near Noleda on the Piedras Pintas salt dome in eastern Duval County by the Empire Gas and Fuel Company. The test found oil at approximately 3500 ft. and made several heads of oil that shot above the crown block of the derrick. A few weeks after an unsuccessful attempt at completion, the test was abandoned after being deepened to 3700 feet. Thus a dry hole resulted in a major drilling campaign. Recently production was found on the dome be-



Standard derrick and drawworks used in Lomo Novio field, Duval County

low 5000 ft., two 400-bbl. producers having been completed there in 1935.

Government Wells Field. The largest field yet developed on the Reynosa escarpment is the Government Wells pool of northwestern Duval County, so named because of several water wells drilled on the site 90 years ago by a federal encampment. The field was discovered August 22, 1928, and has produced in excess of 10,000,000 bbl. of pipe line oil. The discovery well was the Onyx Oil Company's No. 1 N. G. Norton, which was brought in making 150 bbl of 22.5-gravity oil from a depth of 2339-2347 feet. To date, 575 oil wells and 30 gas wells have been completed, and 6600 acres in oil and 1200 in gas proven. The gas areas are characterized by their position on the west side of the sand lens in the Jackson series. The pay sand varies from 18 ft. in thickness in the South Government Wells to 78 ft. in the field proper. The field was developed in three districts: first, the north field was brought in from the upper sand; then, the middle field was discovered in 1929 by J. S. Suttle at his No. 1 O. Bennett, which came in for an initial production of 2000 bbl. of 21-gravity oil; then the south field was discovered in November, 1930, by the Duval Oil Corporation in their well No. 1 Bishop Cattle Company. Thus one of the largest cattle ranches in Southwest Texas was turned into a bonanza oil field.

Lomo Novio. Another million-barrel field was opened in 1934 at Lomo Novio (Spanish for "new hill"), one and three-fourths miles east of the Government Wells field. The discovery well was Humble Oil and Refining Company's No. 1 G. Ruiz, which was brought in producing 50 bbl. of oil per day and some salt water from 2785-2790 ft., about 80 ft. below the main Government Wells sand. By March 17 of the following year, seven oil wells had been completed, one of which, Humble's No. 2 G. Ruiz, produced at the rate of 1080 bbl. of crude per day through ¾-in. choke at a depth of 2805-2816 feet. The development eventually extended five and one-half miles in length and from one to one-and a half miles in width. Prominent operators in this field are the Humble Oil and Refining Company, The Texas Company, Rodney DeLange, Al Buchanan, the Magnolia Petroleum Company, Highland Oil Company, Shell

TABLE I—COLUMNAR SECTION

Reynosa Escarpment District (and Occurrence Chart of Oil and Gas Fields)

System	Series	Group	Formation	Producing Fields
Quaternary	Recent		Wind-blown sand	
	Pliocene		Reynosa	
	Miocene		Oakville sand	
			Catahoula	Barbacoas Rio Grande City
	Oligocene		Frio sand series	Driscoll (2400 ft.) Samfordyce Porter-Roos and Bennett Barbacoas
		Jackson	Fayette sand	Driscoll (2900 ft.) Albercas Alworth Charco Redondo Randado Cuellar Piedras Pintos Mirando Valley Schott Aviators Wolcott Mid-Ojuelos Schoolfield-O'Byrne Kohler Cole Carolina-Tex (2000 ft.) Henne-Winch-Fariss Government Wells
Tertiary	Eocene			Loma Novio Hoffman Rogers-Cuellar Seven Sisters* Lomo Alto* Cuevitas* Roma (192 ft.) Moca Jennings Escobas Hayes Ranch* Martinez Cuellar* Peyote
			Yegua	Bruni (3400 ft.)
		Claiborne	Cook Mtn.	Carolina-Tex (3000 ft.) Crowther Reiser
				Carolina-Tex (4900 ft.) Lopena
			Mt. Selman	
			Carrizo sand	
			Wilcox sand and shales	
			Midway formation	

*Hockleyenais phase of Fayette formation.

Even Helium

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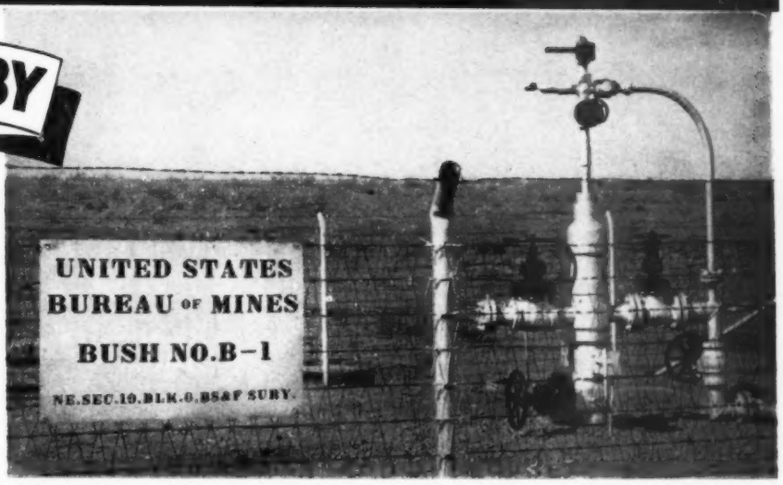

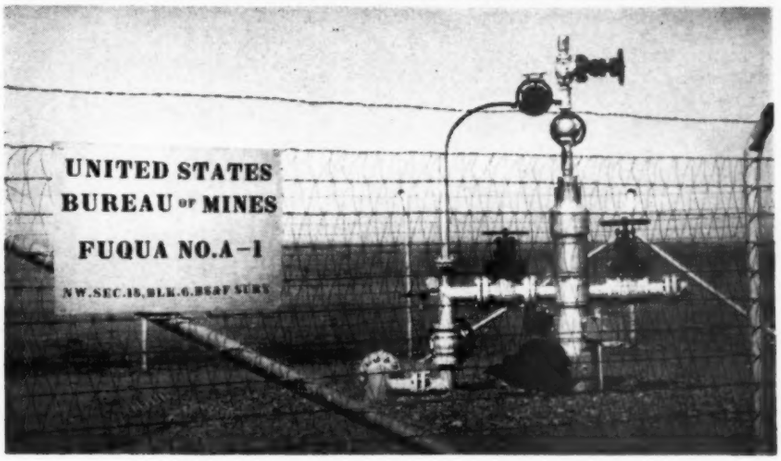

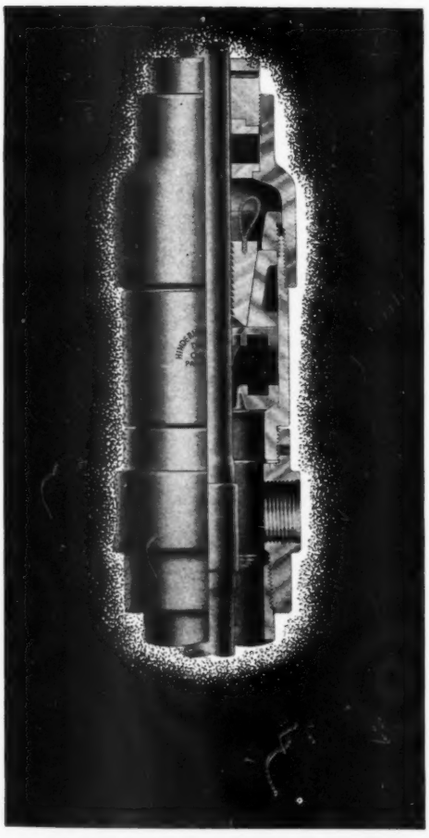

Helium, the "almost perfect" gas, was discovered by P. J. C. Janssen in 1868, while studying the light of the sun spots through a spectroscope.

Helium was first discovered in natural gas and in usable quantities, when a gas well was drilled at Dexter, Cowley County, Kansas, in 1903. When the gas was offered for sale it would not burn, and upon being tested was found to have a very high Helium content.

Helium is a non-combustible gas with great lifting power and having a high conducting power for heat and electricity. Its greatest usage at the present time is in lighter-than-air airships. Due to its scarcity, its peculiar nature and utility, even the slightest loss of the gas containing Helium must be guarded against.

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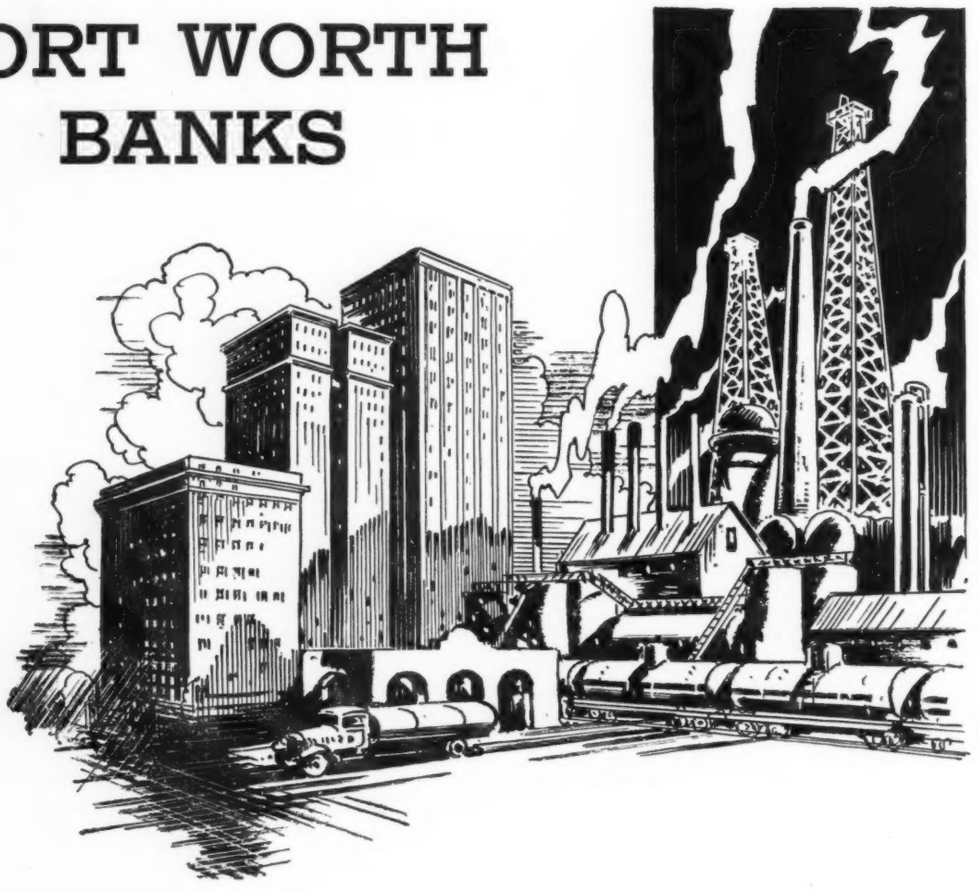

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TABLE 2

Field	County	Depths to Productive Sands
Mirando Valley	Zapata	1450 ft.
Kohler	Duval	1778–2807 ft.
Aviator		1700 ft.
Charco Redondo	Zapata	160–185 ft.
Henne-Winch-Fariss	Jim Hogg	2130–2150 ft.
Alworth	Jim Hogg	1017–1025 ft.
Randado	Jim Hogg	1238–1285 ft.
Schott	Webb	1600–1933 ft.
Cole Gas Pool	Duval	1779–1803 ft.
Cole Oil Field	Webb	2324 ft.
West Cole (Deep)	Webb	3420 ft.
Carolina-Texas	Webb	2505–4911 ft.
Wolcott		1600–1700 ft.
Government Wells	Duval	2339 ft.
Lomo Novio	Duval	2785–2816 ft.
Eagle Hill	Duval	1475 ft.
Moca	Webb	909 ft.

Petroleum Corporation, Hamil & Hamil, and many others. Like Government Wells, the area was developed first at the center portion around the Humble discovery; at the north portion around the Al Buchanan producer; and at the south portion opened by Johnson and Tex-La's No. 1 William Hubbard in Section 84. These areas eventually became one solid producing area. In July, 1935, Magnolia deepened its No. 2 F. W. Herbst to a deeper sand at 2800-2804 feet.

In 1936, a new producing area was opened in the Lomo Novio sand east of the Hoffman field by Rogers & Rogers at their No. 1 Cuellar. Humble participated in this development.

Seven Sisters. In 1936, development also was under way on a large scale in the Seven Sisters field of northern Duval County, northeast of the Government Wells field. Production was developed first in the Hockleyensis zone of the Jackson, then in the Government Wells sand, later in the Lomo Novio sand. Production rates mounted as high as 60 bbl. per hour. Like the Lomo Novio field, much of the production was on the Wood and Welder fee land. Prominent participants in the development included the Humble Oil and Refining Company, Pan-American Production Company, Santa Clara Oil Company (the discovery operator) The Texas Company, Atlantic Oil Producing Company, Blanco and Buchanan, Westheimer and Daube and Navarro Oil Company.

Pay Depths. Depths of production along the course of the Reynosa escarpment vary from only 160 ft. to as deep as 4900 feet. Table 2 is a summary by fields.

DEEPER PAY POSSIBILITIES

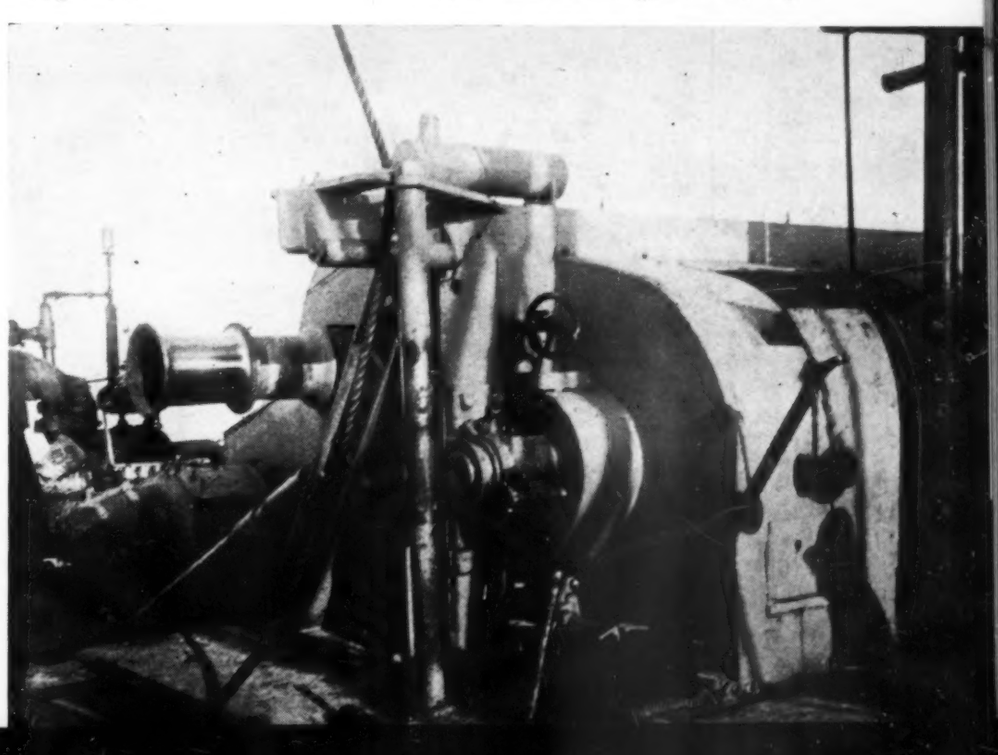
Yegua. A wave of wildcatting for deeper production in the Yegua formation followed discovery in 1934 of deeper pays in the West Cole field at Bruni townsite in southeastern Webb County on the escarpment. The discovery well was United Production Corporation's No. 1, completed June 14, 1934, at a total depth of approximately 3400 feet. The United drilled two oil wells to the deep pay and sold this production to the American Liberty Oil Company in August of the same year. Development spread until more than 25 producers were completed in this pay by the end of the year. Leading operators in the field were O. W. Killam, Highland Oil Company, Magnolia Petroleum Company, Sun Oil Company, Kalmor Oil Company, Herman Brown, and American Liberty Oil Company. United Production Company's second well made 45 bbl. of 41.7-gravity oil per hour through choke.

Mt. Selman. Deeper pay possibilities in the Mt. Selman formation were realized on July 10, 1934, when R. B. Morrison opened a high-pressure gas field east of the townsite of Lopeno in Zapata County. His No. 1 Los Burros Ranch blew in for an initial production of 20,000,000 cu. ft. of gas per day from a total depth of 2170 ft., with a pressure of 970 lb. at the casinghead. By the end of the year six gassers had been completed, with volumes as high as 60,000,000 cu. ft. per day. This was the deepest production geologically in the entire Reynosa escarpment area.

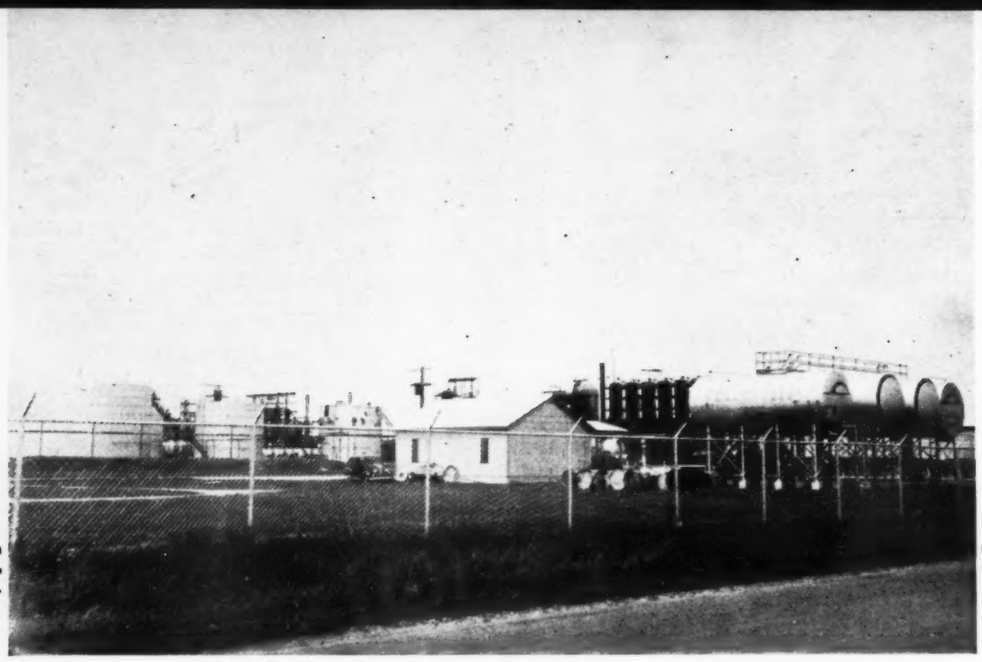
Carolina-Tex. First oil production from the Mt. Selman formation along the escarpment was discovered in 1934 by Carolina-Texas Oil Company in its No. 11 Benavides in the Carolina-Tex oil field of eastern Webb County, drilled to a total depth of 4900 feet. One test drilled by Holland S. Reavis, approximately one mile eastward, proved a failure. Since the discovery, the Mt. Selman has been the objective of numerous tests in Webb, Duval, McMullen, Bee, Karnes, and Live Oak counties.

PIPE LINES

Adequate pipe line facilities in the Reynosa escarpment area are provided by a number of major companies and prominent independents. Humble Oil and Refining Company's 4-in. line serves the Henne-Winch-Fariss field and the Mirando Valley field. A 4-in. line extends from the Henne-Winch-Fariss field to Randado. In addition a 6-in. line extends to the tank farm at Bruni from the main field gathering station. At Bruni, where Humble has at least six 55,000-bbl. tanks, an 8-in. line connects with the Ingleside deep water wharf on Corpus Christi bay.



View of unitized drawworks on rig in Lomo Novio field



Humble Oil and Refining Company's refinery at Ingleside

At Bruni, Houston Oil Company has two 55,000-bbl. tanks, and operates a 6-in. line from the Cole field. At Mirando City, Magnolia has a 4-in. line extending from its tank farm to the Henne-Winch-Fariss field. From Randado to Henne-Winch-Fariss, a 4-in. line is operated by the Randado Pipe Line Company. Humble operates a 4-in. line extending from its Bruni tank farm to Carolina-Texas.

In 1934, Humble Pipe Line Company took up two 4-in. lines from the Government Wells field of Duval County that tied into its main line at Benavides and substituted an 8-inch. The same year, Duval Pipe Line Company extended its facilities to the Government Wells and Sarnosa fields with the terminus at Benavides.

In 1936, the Crude Oil Pipe Line Company laid a two-unit pipe line from the Government Wells field to Corpus Christi, tying in with the terminal at the turning basin. The first unit, which ends at San Diego, is handling 5000 bbl. of oil daily at the time of this writing; the crude is transferred from pipe line to tank car for transportation to Corpus Christi. When completed, the line will handle 8000 bbl. of crude per day.

B—CORPUS CHRISTI DISTRICT

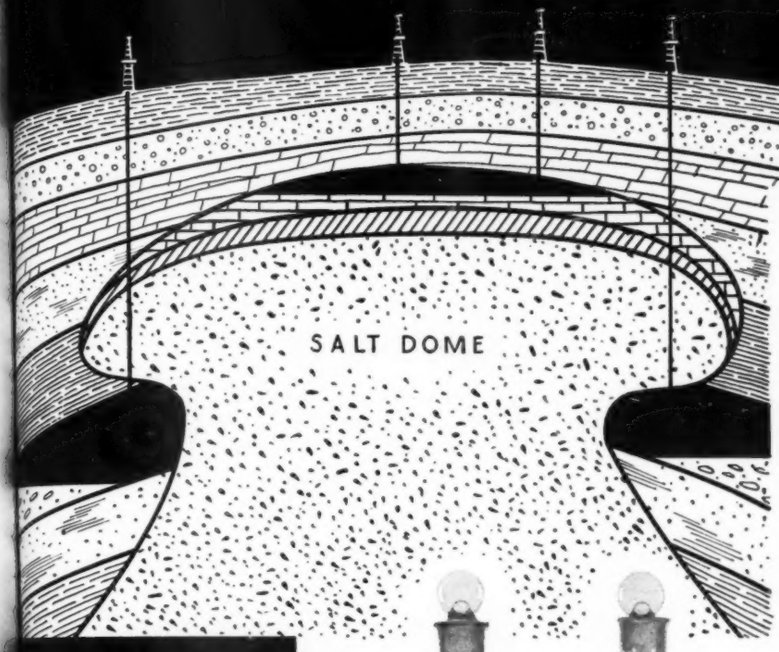
DRILLING AND PRODUCTION

Introduction. The Corpus Christi district in the South Texas Gulf Coast district, an area that has produced oil and gas since 1919, forged to the forefront in the summer of 1935 in oil development as the result of sizeable discoveries at Plymouth pool, in Nueces County, and Clarkwood and Baldwin pools in San Patricio County. By April 1, 1936, 125 rigs were in operation in the area. The district comprises Jim Wells, Kleberg, San Patricio, Nueces, and Aransas counties. For more than ten years it had been primarily a gas-producing area. Oil production is found in the Miocene and Oligocene formations of Tertiary age.

White Point. The Corpus Christi area was first opened in 1919, when a test drilled on the north side of Corpus Christi Bay in San Patricio County blew out from shallow gas sands, then cratered. Several adjacent wells drilled in an effort to make a commercial completion suffered a like fate. Not until November, 1930, was oil production found in the area. At that time, the Saxet Oil Company's No. 17 Rachel was completed for 95 bbl. of 23.4-gravity oil from a plugged-back depth

Special manifold and heater for gas well, Placedo field

BAROID



BAROCO RESISTS FLOCCULATING ACTION OF SALT WATER

BAROCO is a scientifically prepared clay which is substantially unaffected by salt water. It was developed especially for use in Salt Dome Areas and in fields where salt waters exist, and for drilling anhydrite and gypsum formations where the chemical compounds encountered flocculated the mud.

Drilling overhanging salt domes has been a difficult problem with ordinary muds. Salt in the formation caused the mud to settle out, sticking drill pipe and bit and causing costly twist-offs and fishing jobs. BAROCO mud will not "curdle"; therefore it helps to prevent these difficulties.

BAROCO can be mixed directly with brine. It has exceptional wall-building qualities and prevents the passage of large quantities of water from the mud to the formation being drilled. Besides its advantages in drilling, the yield is much better than ordinary clay—about 40 barrels per ton.

Let the Baroid Service Engineer in your territory prove BAROCO'S value to you!

BAROID PRODUCTS

This bottle of salt water contains a native clay commonly used for drilling in Texas. As can be seen, the solids have been flocculated and have settled to the bottom of the container. In a well, these solids might have settled around the bit, causing it to stick.

This bottle, holding the same quantity and concentration of salt water, contains BAROCO in suspension, unaffected by the brine. In addition, BAROCO has much better wall-building qualities than native clays and yields two to three times as many barrels of drilling mud per ton of clay.

BAROID SALES COMPANY

LOS ANGELES • TULSA • HOUSTON

NATIONAL PIGMENTS AND CHEMICAL CO., ST. LOUIS

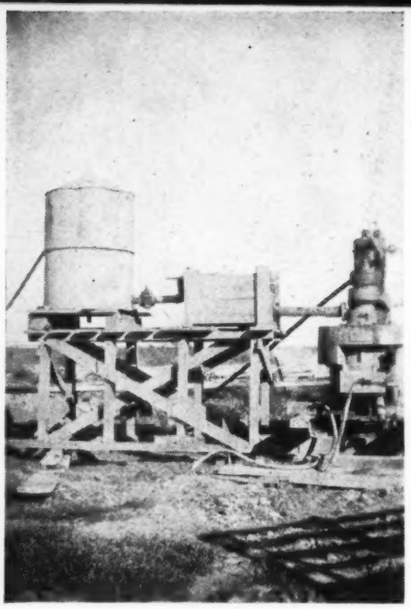
of 4878-4902 ft., under a pressure of 2100 lb. from the Oligocene. Previously 46 gas wells had been completed in the Miocene at depths of 1900 ft., 2200 ft., 2300 ft., and 2500 feet. However, it is comparatively unimportant from an oil producing angle, only 61,099 bbl. of crude having been produced to date.

Kingsville. The first oil pool of any size to be developed in the Corpus Christi district was the Kingsville field of Kleberg County. A water well drilled in 1912 had a showing of gas and pointed out the way for further exploration. The discovery well was brought in during 1920 from a depth of 2143 ft., by the Kleberg Oil and Gas Company with their No. 1 Rosse making an initial production of 50,000,000 cu. ft. of gas per day.

Eighteen oil and 13 gas wells were completed, proving 150 acres productive of oil. To date, the pool has produced 619,648 bbl. of 21-gravity oil.

Saxet. The first million-barrel oil pool to be developed in the Lower Coastal Texas area was discovered January 18, 1923, at Saxet, west of Corpus Christi on the south bank of Nueces Bay. The discovery well was the Saxet Oil Company's No. 1 John Dunn, which was completed at a total depth of 2288 ft. for an initial production of 35,000,000 cu. ft. of gas per day. The discovery oil well was the same company's No. 6 Dunn, which came in for 150 bbl. of 25-gravity oil per day, accompanied by 800 bbl. of salt water. The producing sand was found from 4290 ft. to 4304 feet. To date the area has produced in excess of 2,269,418 bbl. of oil, from a proven area of 320 acres, developed by 47 oil wells. The gas production, developed by 27 wells, comprises 11,420 acres.

Agua Dulce. A comparatively small producing area was opened near Agua Dulce in Nueces County by a small gas well in 1927 from a depth of 1975 ft. and later, on December 24, 1930, oil production was first found by the Houston Oil Company in their No. 1 Comstock. Production was from the Marine Oligocene, and initially the well made 135 bbl. of high-gravity oil per day, accompanied by 40,000,000 cu. ft. of gas. The area has produced to date 121,507 bbl. of oil.



Electrically-operated centrifugal desanding device, installed in 1935 at Union Sulphur Company's No. 4 American Rio Grande Land and Irrigation Company in Mercedes field, Hidalgo County

Premont. A new Marine Oligocene oil producing area was discovered in April, 1933, near Premont in southern Jim Wells County, south of the town of Alice. The discovery well was Magnolia Petroleum Company's No. 1 A. A. Seelingson, and had an initial daily production of 196 bbl. of oil and 15,000,000 cu. ft. of gas from a depth of 3247-4255 ft., with a tubing pressure of 800 lb., and flowing through a 3/8-in. choke. By the beginning of 1926, four oil wells and two gas wells had been completed on the dome.

Plymouth. The scene of a major boom has been the Plymouth field in eastern San Patricio County near the town of Taft. Three pay sands have been found below 5900 ft., yielding high flush production. Following the discovery, development spread to Baldwin, Saxet Heights, Clarkwood, and Taft. During April, 1936, Potter Pipe Line Company of East Texas obtained right-of-way for a pipe line to serve the Saxet, Clarkwood, and Corpus Christi fields, the line to extend to the docks at Corpus Christi harbor. Late in April Benedum & Trees opened a new producing area betwen the Sinton and Plymouth fields with their No. 2 Welder completed at a total depth of 6116 feet.

The Plymouth pool was discovered by the Plymouth Oil Company with its Welder Fee well. Other participants in the development have been the Sun Oil Company, Heep Oil Corporation, and Humble Oil and Refining Company.

TABLE 3—POOL SUMMARY

Nineteen oil and gas fields were developed by April of 1936 in the Corpus Christi district comprising Aransas, Jim Wells, Kleberg, Nueces, and San Patricio counties. They are as follows:

County	Field	Discovery Date	No. Wells		No. Acres		Producing from Ft.	Cumulative Production Bbl.	Gravity of Oil
			Oil	Gas	Oil	Gas			
Aransas	Buckingham	April '36	1	1	20		6532	.....	....
Jim Wells	Armagosa	April '31	0	2		250	2689, 2350	.....	....
	Premont	Nov. '29	4	2		125	3255	3,846	
	Sandia	Nov. '29	0	2		60	2917	.....	
Kleberg	Kingsville	'20	18	13	150	1650	1887-2928	619,648	21
Nueces	Agua Dulce	'27	24	12	200	1600	4913	121,507	29
	Baldwin	July '35	5				4000	.....	
	Clarkwood	'35						.....	
	King	April '32	0	2		650	3889	.....	
	Santa Clara	Nov. '35	1						
	Saxet	'23	46	27	320	11,430	4069-4862	2,269,418	25
	Saxet Heights	'36	8				4000	.....	
	Stratton	Dec. '31	0	1			4801	.....	
San Patricio	Angelita	April '34	2	0	25	.....	5382	25,973	31 5
	Brittan	Dec. '35	1				4900		
	Mathis	.....	2				2400		
	Plymouth	April '35	48			{	5500, 5650, 5911		
	Sinton	May '34	0	2	40	.....	5437	.....	48
	Taft	'36	3				4005, 4915	.....	
	White Point	'19	3	46	40	2900	4902	61,099	23.4

Saxet Heights. One of the most consistent developments has been in the Saxet Heights field, three miles east of the old Saxet field in Nueces

Supply Row, Freer, Duval County

THE *New* ROUGH RIDER CORD ›ENDLESS‹ BELT

Created to do *The* JOB BETTER

ABOVE: *Sectional view showing cords imbedded in rubber.*

A unique construction of many cords, each imbedded in rubber and incased in plies of high-grade duck, explains the ever increasing popularity of the New Rough Rider Cord Belt.

It's Tough It's Super-Flexible
It Will Not Stretch

The belt shown in this illustration has been in continuous service for more than six months, and shows no signs of stretch or wear.

Compared from all angles, ton mile, daily cost, freedom from down time, the New Rough Rider Cord Belt will prove most economical. Especially suited to small pulleys, short centers and unusual drives, this belt meets the most exacting oil field requirements.

Immediately available in all standard endless lengths.

Manufactured by
THE MECHANICAL RUBBER CO.

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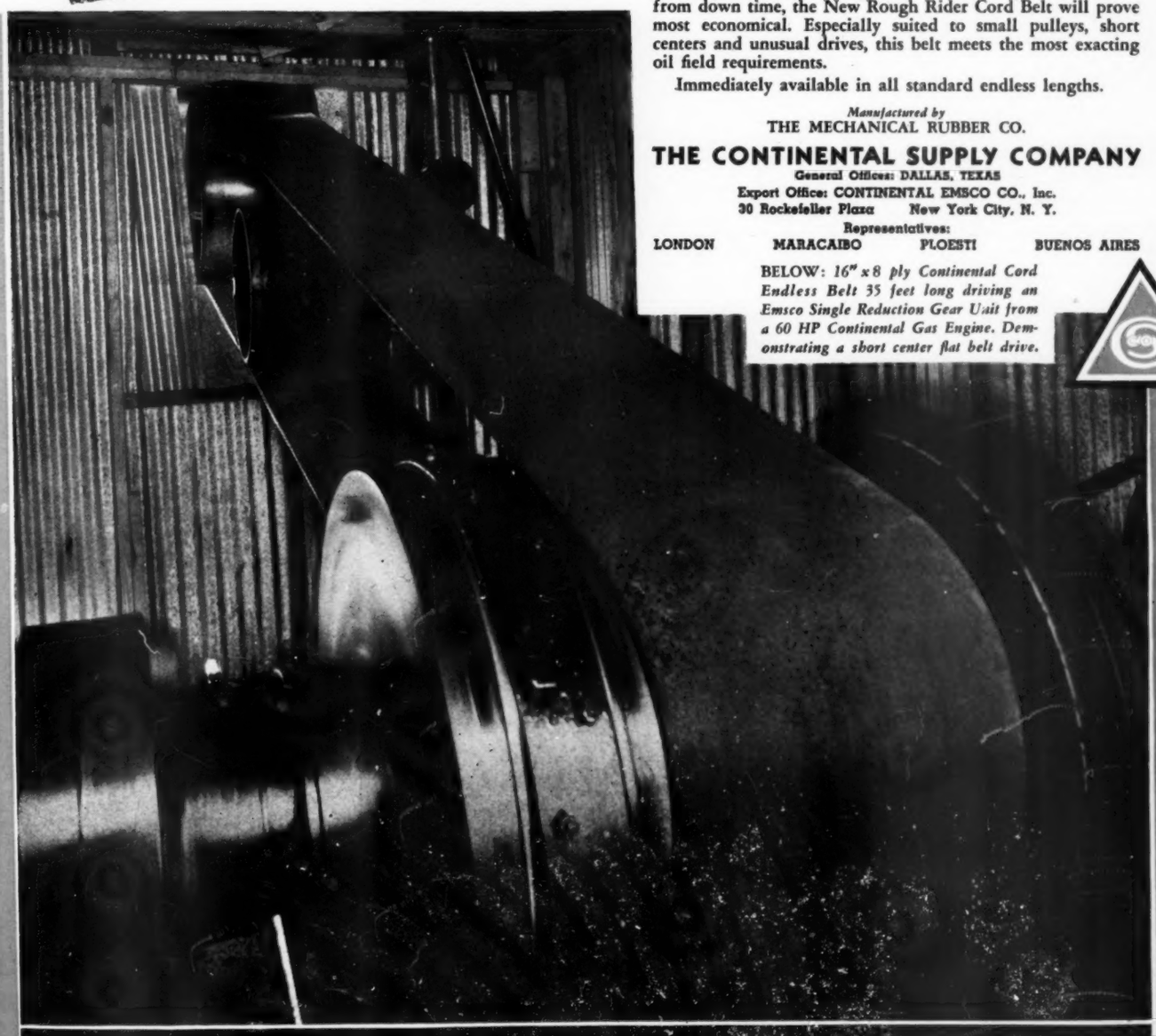
BELOW: *16" x 8 ply Continental Cord Endless Belt 35 feet long driving an Emsco Single Reduction Gear Unit from a 60 HP Continental Gas Engine. Demonstrating a short center flat belt drive.*



CONTINENTAL

SERVING THE OIL AND GAS INDUSTRIES

TABLE 4—OIL PRODUCTION SUMMARY—LOWER DISTRICT—COASTAL TEXAS
(Figures to January 1, 1935)

Field	1930	1931	1932	1933	1934	Accumulated Recovery to Jan. 1, 1935
Agua Dulce	800	18,341	3,472	8,099	103,027	133,134
Armagosa	Gas	Gas	Gas	Gas	Gas	Gas
Keeran			45,458	96,062	100,822	242,342
King	Gas	Gas	Gas	Gas	Gas	Gas
Kingsville	38,748	40,469	27,828	25,844	24,261	616,597
Las	Gas	12,675	25,834	19,614	28,385	82,964
McFadden					6,235	27,740
O'Connor			24,080	21,064	109,435	154,582
Refugio	11,447,473	9,488,123	3,501,073	2,123,414	1,418,849	30,386,270
Sandia	Gas	Gas	Gas	Gas	Gas	Gas
Saxet	9,370	151,490	496,560	876,063	731,854	2,270,317
Stratton						12,214
Welder	Gas	Gas	Gas	Gas	Gas	Gas
White Point	1,080	14,368	19,023	16,200	9,623	60,879
Totals	11,497,471	9,725,466	4,143,328	3,186,360	2,532,494	33,987,049

More Evidence that

COOK'S METALLIC PACKINGS

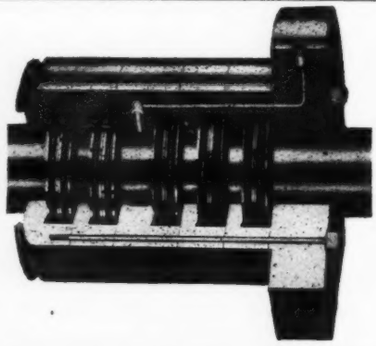


Photo courtesy of the Worthington P. & M. Corp.

...PREDOMINATE IN THE NATURAL GAS INDUSTRY

Wherever you may look throughout the oil and gas fields you will find COOK'S Metallic Packings predominate. A noteworthy installation is the 456 sets of COOK'S Power Packing and 114 sets of COOK'S 800-lb. Compressor Packing in the 57 Worthington Gas Engine Compressors serving the Chicago-Amarillo Natural Gas Line.

"Sealing Pressure Since 1888"

WRITE FOR INFORMATIVE LITERATURE

C. LEE COOK MANUFACTURING CO.

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County. By the latter part of April, 1936, 27 operations were active with eight oil wells producing. A typical completion showed 900 bbl. of oil per day (estimated), produced through a 3/16-in. choke from a total depth of 4080 feet. Active in the field are Circle Oil Company, Westgate Oil Company, Taylor Refining Company, J. K. Culton, and Conroe Drilling Company, as well as others.

Clarkwood. In November, 1936, the Saxet field of Nueces County was extended a short distance southward towards the Clarkwood townsite. Wells were drilled to depths ranging from 4400 ft. to 4423 feet. Development was aided by the Southern Minerals Corporation, Texon Royalty Company, Republic Natural Gas Company, the Houston Oil Company, etc. By the end of April, 1936, 20 rigs were active in the area. Activity became intensified on the Clarkwood townsite, where wells were put down on single lots.

Taft. Two sands have been found in the new Taft area in San Patricio County, opened in 1936. Active in the field are the Shell Petroleum Corporation and Humble Oil and Refining Company. Pay sands are found at 4005 ft. and at 4885-4915 feet.

Rolston. A new oil field was discovered in eastern Jim Wells County on April 23, 1936, two miles west of the old Kings gas field of Nueces County. The well was Lucey Petroleum Company and Texon Royalty Company's No. 1 Rolston, which showed 1000 ft. of oil under 40 lb. pressure on a 15-minute drill-stem test made from 5380 ft. to 5390 ft. after plugging back from 6017 feet. Operators set and cemented pipe to a total depth of 6017 ft., and perforated to complete. It marked the fifth field for the county, other producing areas being Premont, Armagosa, Sandia, and Armstrong-Stewart.

King Ranch. The last stand of the cattle barons in the coastal region of Southwest Texas has given way to the petroleum march of progress in its ever-onward territorial expansion. The million-acre lease embracing portions of seven counties that was purchased in 1933 by the Humble Oil and Refining Company is situated between producing areas—the Kingsville field in Kleberg county on the northeast and the Las Mestenas field of Hidalgo County on the southwest.

The King ranch, whose extent the mammoth lease embraces, shares with the Kenedy ranch the distinction of forming Kenedy County. With a population of only 700 people (all of

KENTUCKY HAD NATION'S FIRST GUSHER

Kentucky's first oil well, the Beatty Well, is accredited as the first flowing oil well in America. It was drilled in 1819 on the south fork of the Cumberland River by David Beatty who was boring for salt water. A hole 9 feet square was dug 10 feet to rock and timbered. Thence a 3" hole was punched by manual labor to a depth of 170 feet and salt water. To the disgust of all, oil began flowing up with the salt water, polluting it,—so the well was abandoned.

Oil filled the well and overflowed, covering the stream for 35 miles, and then caught fire, causing a backwoodsman to originate the expressive phrase "Hell with the lid off."

*One UNION LINE Is Still In Use — After Drilling 7 Wells

Years ago UNION set out with a definite determination to produce "The Ultimate Low-Cost Wire Rope." These words were not adopted as our slogan, however, until hundreds of records of actual field performance had convinced us that UNION Lines *do* last longer. Here is a record of a UNION Line which has done most of the drilling on 7 wells:

This 7/8" 6x19 line was purchased in 1932, in Ohio. There it was used for drilling the last 600 feet in a 4400-foot well, and for drilling another 4400-foot well from top to bottom. The line was then shipped to Kentucky where it was used on a spudder to drill Craven No. 1 (1200 ft.), Kerrick No. 3 (1400 ft.), Ashton No. 2 (1170 ft.), the last 400 feet in a 1600-foot well, and Ashton No. 3 (1600 ft.). Now, after drilling over 10,000 feet in 7 wells, the line is drilling still another well, as shown in the photograph.

This picture, showing 3 generations of Camerons, was taken at H. B. Cameron & Son's Location No. 4, McClean County, Kentucky. The people, left to right, are: H. B. Cameron; Mrs. Walter J. Cameron; Felix Collins, member of crew; Walter J. Cameron, son of H. B.; M. L. Foreman, member of crew; F. A. Donaldson, Union Wire Rope Corp.; F. J. Zogg, Jarecki Mfg. Co., Owensboro, Ky. The young man is James Cameron, son of Mr. and Mrs. Walter J. Cameron.

UNION WIRE ROPE CORPORATION

Executive and Sales Offices: 601 Beacon Life Bldg., Tulsa, Okla.

Factory and General Office: Kansas City Mo. Branch: Portland, Ore. Warehouse: Monahans, Texas

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JARECKI MFG. CO.
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UNION WIRE LINES

The "ULTIMATE LOW COST WIRE ROPE"

whom are employes of the two ranches), this county has resisted until lately all attempts to construct a highway across it. Now a 50-mile shortcut has been afforded motorists who journey from Brownsville to Corpus Christi.

The largest oil lease ever reported to have been signed in the United States was taken in 1933 on the King ranch in southwest Texas by the Humble Oil and Refining Company. It totals 1,225,000 acres in seven counties, principally in Willacy and Kleberg counties, but also includes portions of Cameron, Brooks, Jim Wells, Nueces, and Willacy counties. The reported consideration of $3,500,000 is believed to have been the largest wildcat lease transaction ever consummated. The original King ranch was established in 1850 by Capt. Richard King and Capt. Mifflin Kenedy, who divided their holdings later.

Typical pumping jack used in the Lomo Novio field to handle production at 2700-ft. level

PIPE LINES

Republic Line. The Republic Pipe Line Company recently completed a 4-in. pipe line from the main Saxet field and the Saxet Heights (or Corpus Christi) field to tidewater at the tank farm site of the Republic. Two 80,000-bbl. steel storage tanks were constructed to handle the output drawn from these two fields.

TABLE 5—SURVEY OF OIL PIPE LINES IN SOUTHWEST TEXAS

Company	Length (Miles)	Size (Inches)	From (Counties Shown in Paren.)	To
Atlantic Pipe Line Co. . .	37	8	Refugio (Refugio)	Harbor Island
Atlantic Pipe Line Co. . .	37	6	Refugio (Refugio)	Harbor Island.
Chapman Pipe Line.	10	4	Chapman (Williamson)	Thrall
Carolina-Tex Pipe Line. .	8	3	Carolina-Tex (Webb)	Oilton
Cardinal Pipe Line Co. . .	8	3	Jacobs (McMullen)	Whitsett
Crown Central Pipe Line.	8	4	Mirando City (Webb)	Aviators
Dodd and Weigarten. . . .	8	3 & 4	Los Olmos (Starr)	Rio Grande City
Duval Pipe Line Co.	40	4	Moca (Webb)	Benavides
Deer Oil Corporation. . . .	12	4	Luling (Caldwell)	Darst Creek
Grayburg Oil Co.	55	4	Luling (Caldwell)	San Antonio
Gulf Pipe Line Co.	12	4.5	Luling (Caldwell)	San Antonio
Gulf Pipe Line Co.	. . . .	8	Doris Creek	Crosby
Grayburg Oil Co.	20	4	Somerset (Bexar)	San Antonio
Humble Pipe Line Co. . .	14	6 & 8	Darst Creek(Guadalupe)	Salt Flat
Humble Pipe Line Co. . .	38	4 & 8	Pettus (Bee)	Refugio
Humble Pipe Line Co. . .	29	8	Refugio (Refugio)	Ingleside
Humble Pipe Line Co. . .	8	8	Refugio (Refugio)	Greta
Humble Pipe Line Co. . .	7	8	Refugio (Refugio)	Tom O'Connor
Humble Pipe Line Co. . .	5	4	Kingsville (Kleberg)	Railroad
Humble Pipe Line Co. . .	110	8	Mirando City (Webb)	Ingleside
Humble Pipe Line Co. . .	30	6	Luling (Caldwell)	Hilbig
Humble Pipe Line Co. . .	127	8	Luling (Caldwell)	W. Columbia
Humble Pipe Line Co. . .	28	8	Govt. Wells (Duval)	Benavides
Humble Pipe Line Co. . .	320	10 & 12	Big Lake (Reagan)	Ingleside
Houston Pipe Line Co. . .	8	4	N. Pettus (Bee)	Pettus
Illinois Pipe Line Co. . .	140	10	Yates (Pecos)	Devine
Magnolia Pipe Line Co. .	184	6	Luling (Caldwell)	Mirando City
Magnolia Pipe Line Co. .	210	10	Luling (Caldwell)	Hull
Magnolia Pipe Line Co. .	37	4	Luling (Caldwell)	Yost and Dale
Pioneer Pipe Line Co. . . .	14	2.5	Eckert (Bexar)	Somerset (Bexar)
Pettus Refining Co.	5	2	N. Pettus (Bee)	Pettus
Rosenburg Pipe Line Co.	5	4	Laurel (Webb)	Oilton
Shell Pipe Line Co.	260	10	McCamey (Upton)	Houston
Shell Pipe Line Co.	33	6	Salt Flat (Caldwell)	Bastrop Station
Texas Pipe Line Co.	58	6	Sullivan	RosankeyStation
Texas Pipe Line Co.	250	10 & 12	McCamey (Upton)	Houston
Texas Pipe Line Co.	40	6	San Marcos (Hays)	San Antonio
Texpata Pipe Line Co. . .	17	4	H. W. F. Field	Mirando City
Williamson County Pipe Line Co.	9	4	Chapman (Williamson)	Thrall

NATURAL GASOLINE

Sinton-Plymouth Locality. A line plant has been constructed in the Sinton-Plymouth district of San Patricio County. Operators are the Manhattan Gasoline Company who will handle the gas output from the Plymouth and Sinton fields for processing.

The Manhattan concern is a branch of the Refugio Refining Company. Contract has been signed with the Hanlon-Buchanan, Inc., for handling the output.

TERMINALS

The second largest terminal point in the coastal region of Texas is the Corpus Christi area, including Ingleside, Harbor Island, as well as Corpus Christi proper, now the scene of important development. The largest terminal in the area is that of the General American Tank Storage and Terminal Company at Corpus Christi harbor. The Crude Oil Pipe Line Company's terminal handles the output from the pipe line from the Lomo Novio oil field of northern Duval County. The output of four pipe lines of The Texas Company in this district is handled at the Corpus Christi terminal. Three pipe lines of the Humble Pipe Line Company terminating at Harbor Island and Ingleside, are served by company terminals. At Ingleside, the terminal also is utilized for shipping refined products of the Humble Oil and Refining Company.

At Aransas Pass (Harbor Island) are situated the terminals of the Atlantic Pipe Line Company and the Humble Pipe Line Company. Rates of loading at this point have been as great as 26,000 bbl. per hour.

C—RIO GRANDE VALLEY DISTRICT

DRILLING AND PRODUCTION

Review. One of the looming reserves in Texas that is increasing in importance is the Rio Grande Valley area embracing Hidalgo, Cameron, Willacy, Kenedy, Jim Wells, Brooks, eastern Starr, and Kleberg counties. The real discovery well for the region was Otto Woods No. 1 George in the

southwestern portion of Hidalgo County 18 miles west of Mission, which on September 20, 1934, found gusher production in the Frio sand at a total depth of 2700 ft., filling a 1000-bbl. tank in 33 minutes. The Sam Fordyce development that followed reached a height in the fall of 1935 and at this writing 124 oil wells are on production from four sand lens in the Frio series of the Oligocene.

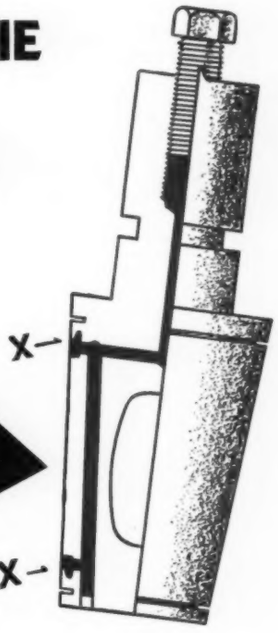
The second major discovery was made six miles north of Mercedes in Hidalgo County April, 1935, when production was found at a depth of 7477 ft. in the Frio series of the Oligocene. This was made after a two-year period of reflection seismograph exploration uncovered a structure with 250 ft. of closure. Northwest of the Mercedes pool, Kayser and Deering of Houston in June, 1935, opened another Frio sand field two and one-half miles northeast of Edinburg, county seat of Hidalgo, at a plugged-back depth of 6700 feet. It is now known as the Las Mestenas field. In February, 1936, a Frio gas pool was discovered near Garciaville, six miles west of Sam Fordyce but in southeastern Starr County, by Clopton Bros. No. 3 Roos & Bennett, which blew in at a depth of 2450 ft. as a high-pressure gas well.

Proof of a shallow salt dome in Willacy County to the east was revealed by a 3150-ft. dry hole drilled years ago on the La Sal del Rey prospect in the northwestern portion of the county. Seismograph exploration has since indicated anomalies in Willacy and Cameron counties of the salt-dome type. Moreover, a shallow sulphur dome has been mapped southeast of Matamoras in the Tamaulipas province in northern Mexico, all of which proves existence of a salt dome basin.

Future Possibilities. Like the Coastal Texas and Coastal Louisiana portions of the Gulf of Mexico embayment, a Miocene overlap of the Oligocene exists in the Rio Grande Valley embayment. Existence of a huge basin, one of the largest on the North American continent, in northern Mexico, as indicated by the encountering of 5000 ft. of Midway formation on the Guerrero dome opposite Zapata County, indicates that major reserves will

This picture shows you

WHY MacCLATCHIE "HYDRO SEAL" PLUG VALVES ARE BETTER



Undercut grooves in the surface of the plug form metal "Hydro-Seal" lips which are expanded by grease pressure applied by a booster screw. The fine, razor-like edges of the "Hydro-Seal" lips engaging against the wall of the body make escape of pressure impossible. The bearing surface between the plug and the body is amply lubricated. The plugs on high pressure models turn on ball bearings.

"Hydro-Seal" lips eliminate compressible packing, thereby reducing friction to a minimum. Users throughout the world say that MacClatchie Valves Turn Easily . . Hold More Pressure . . and last longer. SPECIFY THEM AND BE CONVINCED. Made in screw, flange and union ends, hand or gear operated in working pressures for 250 lbs. to 3000 lbs.

There is an outstanding reason why each MacClatchie Tool gives better service. This is one of a series of ads telling WHY.

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TABLE 6—REFINERIES

Summary—The following list gives details by districts of all refineries in the Southwest Texas oil region:

Refinery Operator	Location	County	Plant Capacity	Type
A. Reynosa Escarpment District				
Chappa Ref. Co.	Laredo	Webb	65	Shell Still
Tex-Mex Refining Co.	Laredo	Webb	350	Steam Still
Hausman Brothers	Laredo	Webb	70	Topping Plant
Motor Fuel Producers	Laredo	Webb	1,200	Skim. & Crack.
Amasco	Mirando City	Zapata	2,700	Skim. & Crack.
Hall Refining Co.	Oilton	Webb	70	Skimming
B. Rio Grande District				
Valley Refining Co.	Harlingen	Cameron	200	Shell Still
Coastal Refineries Inc.	Pt. Isabel	Cameron	5,000	
Valley Refining Co.	McAllen	Hidalgo	100	Shell Still
C. Corpus Christi District				
Humble Oil & Ref. Co.	Ingleside	San Patricio	20,000	Skim. & Crack.
Corpus Christi Ref. Co.	Corpus Christi	Nueces	1,500	Skimming
Egglestone Refinery	Corpus Christi	Nueces	250	Skimming
Clymore Gasoline Co.	Agua Dulce	Nueces	18,000	Nat. Gasoline
Manhattan Gasoline Co.	Sinton-Plymouth	San Patricio	7,500	gal. Abs. Gasol.

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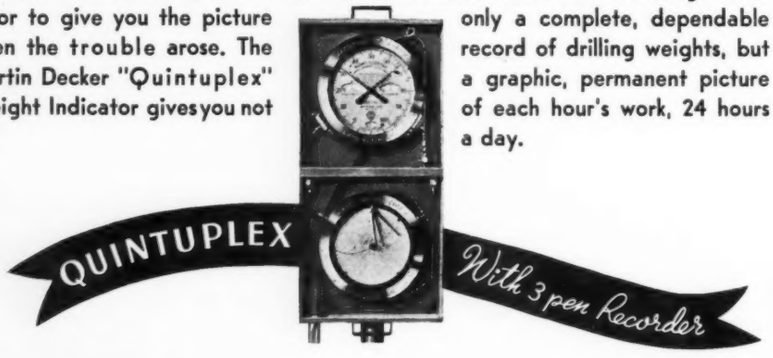
Of all the things that affect drilling progress and results, weight on the bit and strain on the lines and derrick are vitally important. Twist-offs, broken lines, pulled-in derricks, bits run bald-headed, crooked holes and many other common drilling troubles are all too often due to carrying too much or too little weight on the bit, but you cannot avoid repetitions of these things or be sure what caused them, unless there is an automatic recorder on the weight indicator to give you the picture when the trouble arose. The Martin Decker "Quintuplex" Weight Indicator gives you not only a complete, dependable record of drilling weights, but a graphic, permanent picture of each hour's work, 24 hours a day.



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accumulate at the edge-lines of the numerous sands already known to exist in the Eocene, Oligocene, and Miocene formations, particularly in the Vicksburg, the hockleyensis phase of the Jackson, the Yegua, and the Mt. Selman, as well as the Catahoula Miocene. Production may be found as shallow as 7000 ft. on some of the shallower domes in the coastward portion of the embayment. Production will be characterized by high gas pressures and faulted structures, due to the highly-compressed northwest-southeast trend of the folds within the influence of the Sierra Madre Oriental range, which causes mountain-type folding, even though submerged. Due to the great thickness of gravel beds in the Rio Grande extension of the Reynosa escarpment, the use of the torsion balance and the magnetometer and other geophysical methods will be utilized to a greater extent than the reflection seismograph. Lack of surface mounds, although salt deposits exist, renders detection of structure from the surface almost impossible.

EARLY HISTORY

Indians, who dug by hand a well 11 miles northwest of Rio Grande City, were first to utilize the oil in the Rio Grande Valley. Surface oil flowing into the cavity served for medicinal and fuel purposes. The site, known as the "Old Indian Well", was the incentive for many wildcatters to prospect in Starr County.

So the first record of drilling for oil in the valley dates from 1910, and was on the edge of the old Indian seep hole. The Huisache Oil Company put down a 956-ft. test at section 7, in porcion 76, of the ancient jurisdiction of Camargo, but the test failed to produce.

The following year, another test was sunk in section eight, porcion 87, in the same jurisdiction but it too proved unproductive. It was known as the Producers well.

Gas production was found in commercial quantities nearby, however, by the Mercedes Oil Company headed by Mr. Rutledge, in test wells near the banks of Little Los Olmos creek.

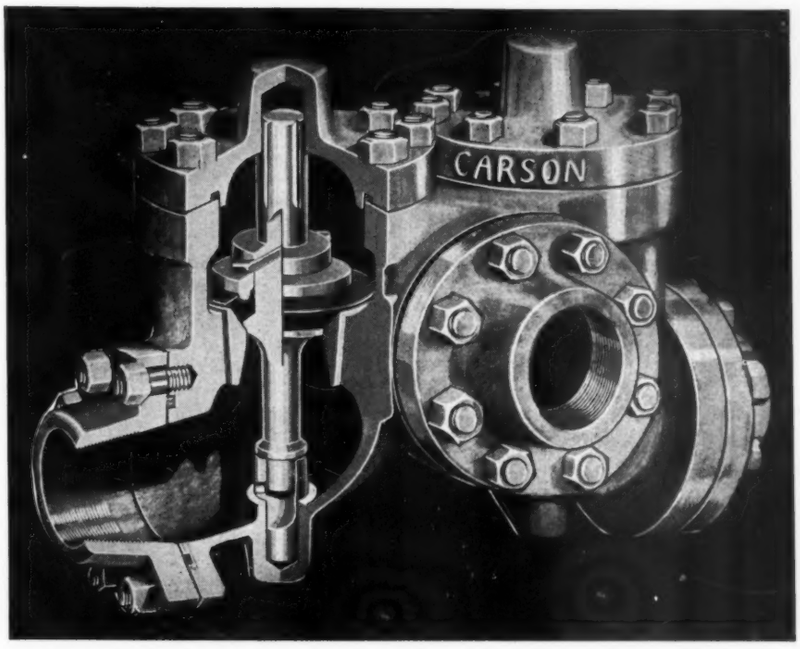
Activity Lagged. For 15 years oil activity in the Rio Grande Valley

lagged. In 1926, Woodruff & Clark drilled an 860-ft. dry hole in section nine, porcion 95, ancient jurisdiction of Camargo in southern Starr County. Two years later Kusch and Sullivan, Rio Grande City and Premont operators, saw their test blow out; but the heavy flow of gas played out after blowing for several hours. But these partners were not dismayed and two years later were rewarded by opening a small gas field in section eight, porcion 75, ancient jurisdiction of Camargo. Dry holes were drilled by Day Oil Company, Sullivan & Clements, Ed Sullivan, and others.

Los Olmos. The discovery oil well for Starr County was brought in October 30, 1930, opening what is now known as the Los Olmos pool, north of Rio Grande City. The pioneer in the area was the Los Olmos Oil and Gas Company, a local concern, which found production at a depth of 386 ft. at their No. 1 Kelsey-Bass in section six, porcion 76, Camargo jurisdiction. It made a small quantity of 18.5-gravity oil, having a rock pressure of 120 pounds. Previously, Mercedes Oil and Gas Company's No. 3 Bass gauged 2,000,000 cu. ft. of gas per day from 528 ft. to 540 feet. To date 250 acres have been proven for oil and 100 acres for gas. More than 225,000 bbl. of oil have been produced.

Roma. The next oil producing area to be discovered was the Roma pool, extending from a point north of Roma southward into Mexico. The pool-opener was a gas well, M. Guerra's No. 1 Fee, completed October 27, 1927, for an initial production of 1,500,000 cu. ft. of gas per day from a depth of 192-200 feet. Oil was discovered by The Texas Company with their No. 4-A D. Guerra. It was completed December 17, 1929, for an initial daily production of 45 bbl. of 35-gravity oil from 3560 ft. to 3566 feet. Production is from the upper portion of the Mt. Selman formation, of lower Eocene age. To date but one oil well has been drilled and four gassers. Only 6600 bbl. have been produced from the solitary oil well. The Texas Company holds the bulk of the acreage on the structure.

Cuevitas. The Cuevitas oil field of



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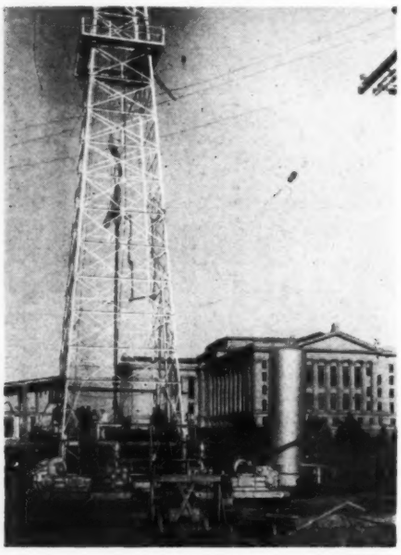
northern Starr County also is in the Reynosa escarpment province. It was opened in June, 1933, by the Sun Oil Company, which found the field by means of surface indications. The discovery well was their No. 1-A M. Guerra and Sons, completed at a depth of 2209-19 ft. for an initial production of 17,000,000 cu. ft. of gas per day. Upon deepening to 2233 ft., the well made 385 bbl. of oil and 3,500,000 cu. ft. of gas per day, produced through 3/8-in. choke. To date but 1250 bbl. of oil have been produced from nine oil wells. Six gas wells have been completed on this dome. Pay sand is found in the Hockleneysis phase of the Jackson.

Barbacoas. The Barbacoas oil and gas field of eastern Starr County was opened May 4, 1933, by the Jeffries-Lambeth Drilling Company who completed their No. 1 Starr County Cattle Company at a depth of 2450-65 ft., for an initial production of 15,000,000 cu. ft. of gas. Although six gas wells were brought in on the structure, only one oil well was completed.



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Rio Grande City. North of Camp Ringgold, famous federal fort on the Rio Grande, an oilfield was opened in porciones 80 and 81 in southern Starr County on May 31, 1932. Heard and Heard's No. 1 Wood et al was brought in from a depth of 1375-80 ft. for an initial production of 75 bbl. or 27.3-gravity oil. The area proved to be spotty and only ten oil wells were completed out of 30 tests. A productive area of 60 acres was outlined. Recent use of electrical logging equipment may uncover a shallower pay at 1100 ft., on the northwest flank. A faulted fracture zone transverses the field northwest to southeast, within which little production has been found.

Sam Fordyce. The largest gusher pool yet discovered in the Rio Grande Valley sector was opened September 20, 1934, by Otto Woods et al with his No. 1 John M. Lawrence which came in filling a 1000-bbl. tank in 60 minutes. Pay sand was found at 2700 ft. in the Frio. Development soon established the contact between the gas on the north and the salt water on the south. In 1935, the field was extended into Starr County on the fee land of the Yturria Land and Improvement Company. Four distinct sand lens were found in the development of the field. Operators in the field include Weekly Oil Corporation, Navarro Oil Company, King-Woods Oil Company, Harrison and Davis, Cortez Oil Corporation, Barnsdall Oil Company, Phillips Petroleum Company, Ben G. Barnett, Frank Powell, and others. By February, 1936, 124 oil wells had been placed on production.

Mercedes. Existence of mile-deep oil reserves was proven in April, 1935, when the Union Sulphur Company, of New York, N. Y., and Sulphur, Louisiana, opened a new Frio sand field seven miles north of Mercedes in eastern Hidalgo County at a depth of 7477-7493 feet The discovery well was their No. 3 American Rio Grande Land and Irrigation Company, completed for 240 bbl. of 57-gravity crude oil per day through a 1/4-in. choke. Tubing pressure registered 650 lb. while the casing

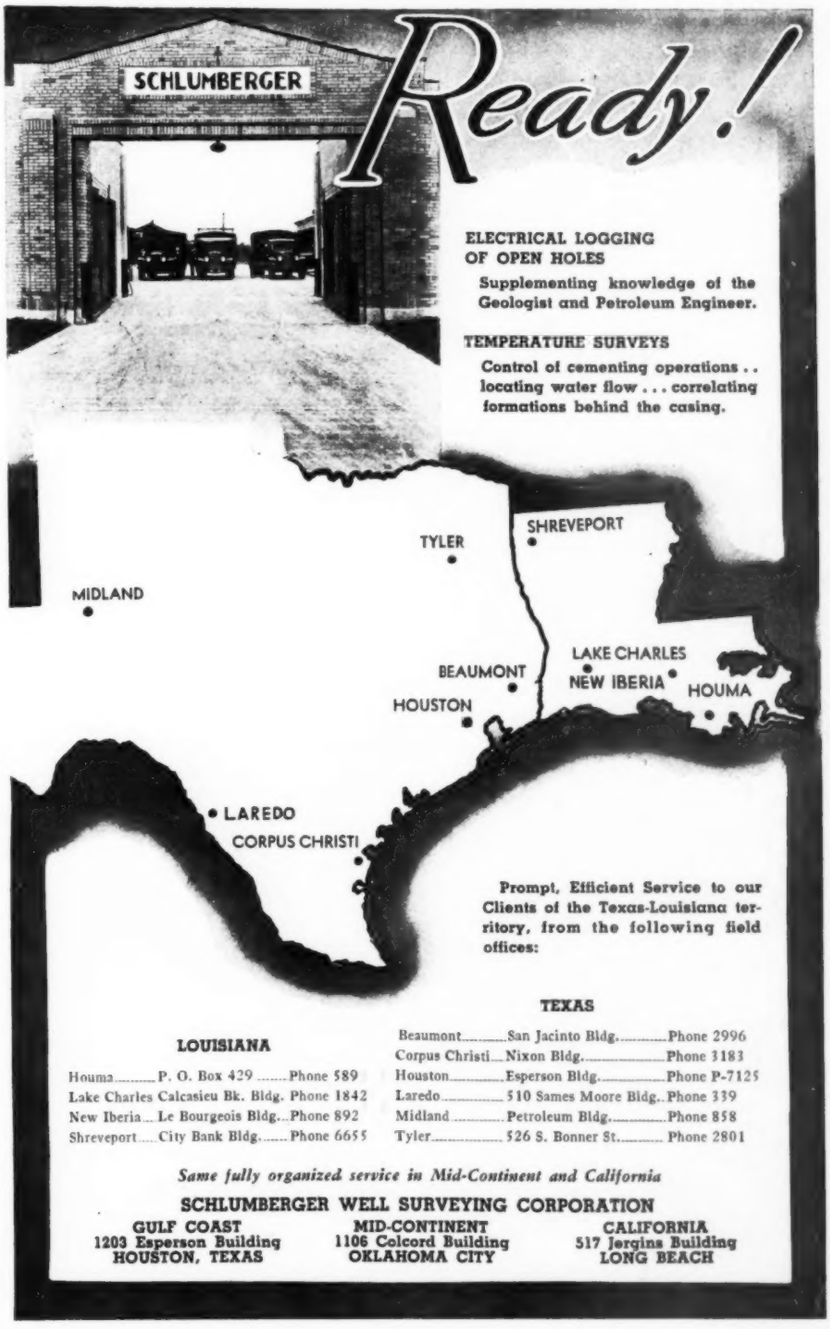
pressure was 900 pounds. The discovery well was on a block of 3500 acres assembled by McCollum Exploration Company after a reflection seismograph survey made known the structure. Operators had drilled two tests to an average depth of 6200 ft. each before their No. 3 found the producing formation, one of the tests, No. 2, having been junked. No. 1, which had been temporarily shut down below 6500 ft., was deepened to the discovery pay; No. 4, drilled on the southwest flank, was a dry hole. Their No. 5, drilled northwest of the discovery, proved a producer, likewise Nos. 6 and 7 on the northeast and east flanks of the dome, respectively. The structure trends north 10 deg. west, with a deep-seated flank evident on the northeast flank, as is typical of several of the mountain-type structures across the Rio Grande in northern Mexico. Market for the crude is a refinery at Harlingen, the crude for which is hauled from the field by truck.

Las Mestenas. In June, 1935, Paul A. Kayser and John A. Deering, of Houston, took over from the Union Sulphur Company a 7000-ft. test that had been shut down, and after running electrical logging equipment, completed it at 6700 ft. as a distillate-gas well. It is on the Engelman Gardens tract northeast of Edinburg, county seat of Hidalgo. In 1936 development was resumed by Kayser and Derring, who started their No. 2 Engelman one mile south and one-eighth mile east of the discovery well. It is on the same trend and of the same type structure as Mercedes. Pan-American Production Company, (Standard Oil Company of Indiana subsidiary) and Quintana Petroleum Company of Houston entered this area in February, 1936.

Garciaville. Another Frio sand field was opened in January, 1936, north of the town of Garciaville, a Mexican village southeast of Rio Grande City in Starr County, six miles west of Sam Fordyce. The discovery well, designated as Clopton Bros. No. 3 Roos & Bennett, blew in making 15,000,000 cu. ft. of gas per day at 2450 ft. through perforated casing, after an electrical logging device indicated saturated zones to test after setting pipe.

Sam Fordyce Revived by Oil. The only "Ghost city" of the Lower Rio Grande Valley staged a comeback as the result of the discovery of the Sam Fordyce oil field in 1934. Eighteen years ago, Sam Fordyce, near the Rio Grande border in southwestern Hidalgo County, was a concentration point for thousands of U. S. soldiers sent there to conquer the many bandit gangs that constantly infested the frontier. During the ensuing three years the town was a beehive of activity as thousands of dollars were spent in construction of military barracks, warehouses and other federal structures. A first-class military highway paralleled the border.

Today, the town is only a ghost of its original self with only two ramshackle buildings remaining to indicate the glory of bygone days. Rusted army trucks and old army camp paraphernalia comprise the remainder of the once famous "jumping off" point, now overgrown with thorny brush, typical of the border country. Oddly enough, only a few months before discovery of the Sam Fordyce oil field, the depot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was closed, the Missouri Pacific railroad having been granted permission by the Interstate Commerce Commission to do so, because of a lack of trade for the terminal. The depot was boarded up but only for a few weeks.

REFINING

A $350,000 oil refinery was completed on December 5, 1935, at Port Isabel, on the gulf coast in Cameron County. The plant, that of the Coastal Refinery, Inc., was developed by T. Frank Murchison, Dallas, and G. L. Rowsey, Tyler, principal stockholders in the concern. The daily capacity is 5000 bbl. on a 24-hour day schedule. Gasoline, heating oil, and fuel oil are the products of this plant. The refinery has a storage capacity of 75,000 bbl. for crude oil, 25,000 bbl. for gasoline, 25,000 bbl. for heating oil, and 55,000 bbl. for fuel oil. On the tank farm there are 25 tanks with a total capacity of 225,000 barrels. The chief source of crude for the plant is the Sam Fordyce oil field, 85 miles westward. Most of the output is shipped by boat to a New Jersey market served with a regular weekly sailing.

PIPE LINES

The principal pipe line outlet for the Rio Grande Valley district is the 85-mile 4-in. line of the Valley Pipe Line Company, extending from the Sam Fordyce field in southwestern Hidalgo County to the 5000-bbl. capacity plant of the Coastal Refinery, Inc., at Port Isabel in Cameron County on the gulf coast.

D—FRIO-ZAVALLA COUNTY DISTRICT

Frio County. Another region in southwest Texas was proven productive of oil when Amerada Petroleum Corporation and Rycade's (Houston) No. 2 Halff & Oppenheimer, four miles south of Pearsall, in southwestern Frio County, blew in December 2, 1935, spraying 12,000,000 cu. ft. of gas and ten bbl. of live, black oil per day. The producing horizon is the Navarro formation and the pay zone found from 3936 ft. to 3950 ft., where the casing was perforated. The well is on an 83,000 acre block.

The discovery, 65 miles southwest of San Antonio, marks the first oil production for the LaSalle uplift, embracing Dimmit, Zavalla, LaSalle, and Frio counties.

Although it is the region's first oil well, it is the second gasser on the structure, being 16 miles northeast of the same operators' No. 1 F. Doering in the M. L. Carranza survey No. 302, which was completed on April 4, 1935, for an initial of 1,410,000 cu. ft. of gas from a depth of 6459 ft. in the Buda lime.

Buda Lime. A new oil-producing formation was proven for the southwest Texas region when gusher production was encountered in the Buda lime on September 13, 1935, in the Smith oil field of southwestern Frio County. Amerada Petroleum Corporation and Rycade Oil Corporation's No. 1 Smith was completed for an initial production of 79 bbl. of 39.1-gravity oil per hour through a 1-in. choke.

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from this information had been developed in northern Falls County near the town of Marlin. Production was obtained from the upthrow side of a regional fault in the Balcones Fault system.

The Del Rio clay, which lies immediately below the Buda lime, between that formation and the Georgetown line, provides an excellent source bed for the crude oil.

Cow Hill. On a southwest producing extension of the main Balcones fault zone, a small gas pool was discovered in 1926 at a depth of only 800 ft. on the Ike Pryor ranch at what is known as "Cow Hill" in northeastern Zavalla County, near the Uvalde County line. Indications in water wells and geological information pointed the way to discovery of production. To date, five gas wells have been completed out of 12 test wells drilled.

Chittim Ranch Wells. One of the deepest gas-producing areas opened up in Southwest Texas was discovered in 1926 on the Chittim ranch in north-central Maverick county by the Rycade Petroleum Corporation in the Glenrose lime member of the Trinity formation at a depth of 5520 feet. This proved the productivity of the Chittim anticline, a regional flexure measuring approximately 50 miles in length, trending in a northwest-southeast direction across Dimmitt, Zavalla, and Maverick Counties. It is related to the mountain-type of regional structures in the Tamaulipas and Nuevo Leon provinces of northern Mexico, being parallel to them to the northeast. On the southeast extremity of this anticline, a wildcat well in Dimmitt County at Diamond Half Oil Company's No. 1 Eardley showed considerable gas on drill-stem test.

The discovery well of the Chittim gas pool was completed in 1926 at Rycade Petroleum Company's No. 1 Chittim in the southwest corner of section 116. The initial production was 28,000,000 cu. ft. of wet gas per day and a considerable amount of high-gravity oil estimated at 45 bbl. per day. Pay sand was found in Glenrose limestone from 5520 to 5580 feet. The next producer was completed in May of 1930 as their No. 3 Chittim, one location north of No. 1 Chittim gasser in section 116, and had an initial production of 12,000,000 cu. ft. of gas per day from 5520 to 5590 ft. in the Glenrose limestone. The productivity of the Georgetown limestone was indicated by the fact that at a depth of 3205 ft., 44-gravity oil flowed by heads from the Georgetown at the rate of 150 bbl. of oil per day during a period of 36 hours.

The third producer was completed in June, 1931, at their No. 5 Chittim for an initial production of 7,500,000 cu. ft. of gas per day from 5540 to 5572 ft. in the Glenrose limestone. A test made from the gas showed three gallons of gasoline per thousand cu. ft. of gas. The fourth producer was completed at No. 6 Chittim, north of No. 3 Chittim. Its initial production was 4,500,000 cu. ft. of gas per day from 5525 to 5570 ft., accompanied by 70 bbl. of 65-gravity distillate per day. To date only four gas wells have been completed on the dome, all in the Glenrose lime phase of the Trinity formation.

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Chart Covers Critical Period of Oil Production in Texas

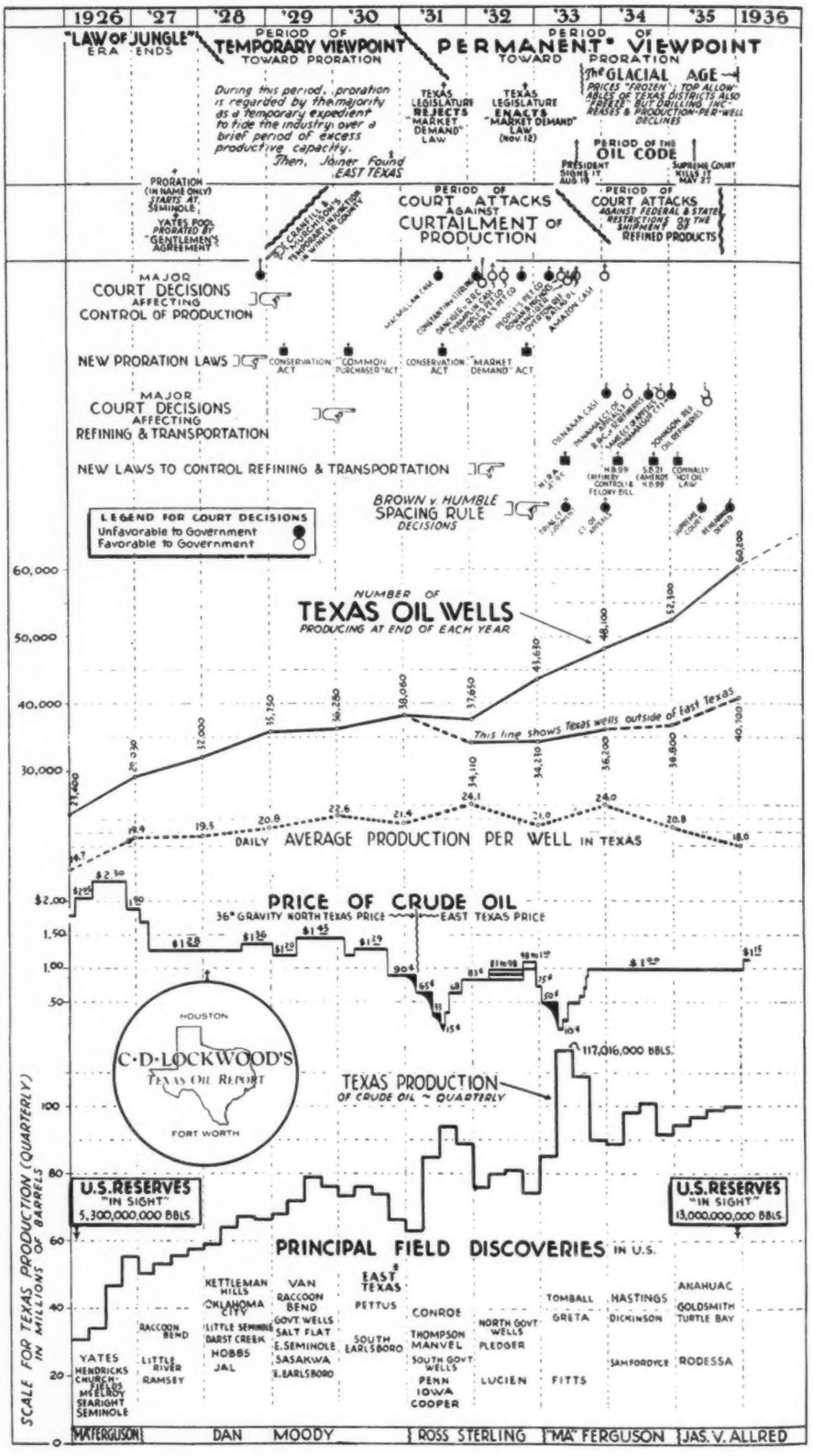
THIS chart, published by courtesy of C. D. Lockwood's Texas Oil Report, cleverly and concisely portrays the history of crude oil production in Texas from the beginning of 1926 to the end of 1935. It will be noted that production for the first quarter of 1926 was, in round numbers, 30 million bbl., and for the last quarter of 1935 some 100 million bbl. —an increase of more than 330 percent in ten years. This period saw the "law of the jungle" lose its potency and the practice of proration established.

There will be observed also violent fluctuations in the price of crude oil. It rose to a peak of $2.30 a bbl. in the latter half of 1926 and held at this level for about six months; less than six months later it had dropped to $1.28 a bbl.—almost half the peak price during the 10-year period. During the early development of the East Texas field when excessive overproduction was rampant, the price fell to 15 cents a bbl. and to 10 cents a bbl. on two separate occasions within two years. The relatively long period of $1.00 oil from the fall of 1933 to the close of 1935 was largely due to the Oil Code.

The number of producing wells increased from 23,400 at the beginning of 1926 to 60,200 at the end of 1935. More than half of this increase, 19,500 wells to be exact, was due to development of the East Texas field.

Interesting to note is the average production per well. At the end of 1935, when proration was in effect, it was 18.0 bbl. as compared with 14.7 bbl. at the beginning of 1926, when there was no proration. During the 10-year period a peak of 24.1 bbl. per well was reached in 1931.

As can be seen from the upper part of the chart, this 10-year period was a turbulent one during which many court battles were fought over federal and state regulations affecting chiefly the control of production. The chart takes on added value because of the fact that it covers what thus far has proved to be the most critical period of the petroleum industry in Texas.



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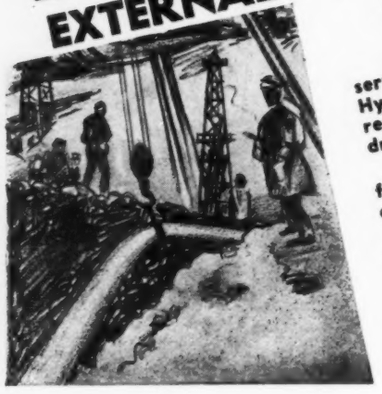

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Review of Petroleum Development in West Central Texas

DRILLING AND PRODUCTION

Introduction. The west-central district of Texas comprises 27 counties and embraces more than 24,000 square miles. Production is found from depths as shallow as 300 ft. to greater than 4500 ft., in the Pennsylvanian, the Bend series of the Mississippian, and the Ellenburger phase of the Ordovician. The principal major structure is the Bend arch monocline on the north flank of the Llano-Burnet uplift originating in Llano, Burnet, and San Saba counties. During the past four years, acid treatment of lime wells has revived to a major extent production in Archer, Young, and Stephens counties, and has been responsible for the exploratory drilling in the Gunsight lime and for the plugging-back jobs to that formation since 1932 in Archer and Young counties.

Oil produced in west-central Texas ranges in gravity from 30 to 44 deg. A.P.I., and is a sweet crude. The area is a favorite of independent operators, especially in Archer, Young, Shackelford, Jack, and Callahan counties, due to the low drilling cost, the comparatively high-gravity crude, and the good market demand. To date 36 oil and gas fields have been developed in 17 counties. In addition, ten wildcat counties are included within potentially productive territory.

EARLY HISTORY

Ranger. One of the most spectacular chapters in Texas oil history, as all oil men know, is the discovery and development of Ranger. The pioneer of the area is W. K. Gordon, a young railroad surveying engineer who came to Texas about 1913, primarily to survey the route from Dublin to Strawn. At the time he discovered coal along the course of the right-of-way, and organized the Texas and Pacific Coal Company to exploit it. Later this company was taken over by a prominent banking firm of New York City. Not satisfied with the coal possibilities and sensing that the Electra field to the north was in the same province, Gordon set about ascertaining the oil possibilities of the area. In 1917 he obtained (for his eastern firm, the Texas and Pacific), a lease covering 18,000 acres in Eastland County, including the town of Ranger, from the citizens of that town for a drilling contract. Previous to this, modest discoveries had been made in 1914 at Moran and at Strawn in 1915.

The test well was put down during 1917 with the approval of the New York offices at a location made by Gordon three-fourths of a mile from Ranger. Drilling proceeded to 2000-3000 ft. without results, or indications of oil and gas. The home offices were doubtful that the area was more than a coal territory. Finally his New York organization wired young Gordon to pull the tools out of the hole and quit drilling. At the time, with the well down 3235 ft., Gordon, for some reason or another, disregarded orders, although he had kept New York informed with daily telegrams. On his own responsibility, he drilled deeper and only 200 ft. below he brought in the gusher discovery that marked the beginning of Ranger. The pool-opener blew in for an initial production of 1800 bbl. of oil per day.

Overnight, the Eastland County oil center became the mecca of oil men throughout the Mid-Continent and, like mushrooms, derricks sprouted overnight. Eight pipe lines were constructed to transport the flood of oil that soon flowed from the McClesky sand, found in the Marble Falls limestone, and ranged from 25 ft. to 50 ft. in thickness.

Railroad traffic boomed. At Ranger, the Texas and Pacific Railway earnings for the year 1917 were less than $100,000, but the following year jumped to nearly $2,500,000, and in 1919 went to more than $8,000,000, diminishing in 1923 to $1,600,000. The activity was felt at Strawn and at Cisco, 35 miles away. The railroad extended its line to Breckenridge to the north in Stephens County, where the prolific Breckenridge lime was pro-

May showing producing fields in West Central Texas

ductive at about 3000 feet. Eastland and Albany became oil centers, too.

The Strawn field covered portions of three counties: Eastland, Palo Pinto, and Stephens.

Production was found in eight horizons: in the base of the Canyon, in the middle of the Strawn, in the Smithwick shale from sand lenses, at the contact of the Marble Falls limestone and the Smithwick shale, and in four sands in the Marble Falls limestones. The gravity of the crude ranged from 34- to 40-deg. A.P.I. and was of an olive-green color.

The occurrence of oil was on several parallel folds, closely spaced on the broad regional structural feature known as the Bend arch, which comprises a northward dipping monocline, the center of uplift of which was in Llano-Burnet counties.

In 1920, Desdemona in the Ranger district came into the limelight and the resulting activity boosted Texas production for that year to 96,868,000 barrels.

In 1921, Magnolia Petroleum Company laid a trunk line from its Corsicana refinery to the new Ranger development. Five years later, this line was extended to the West Texas fields.

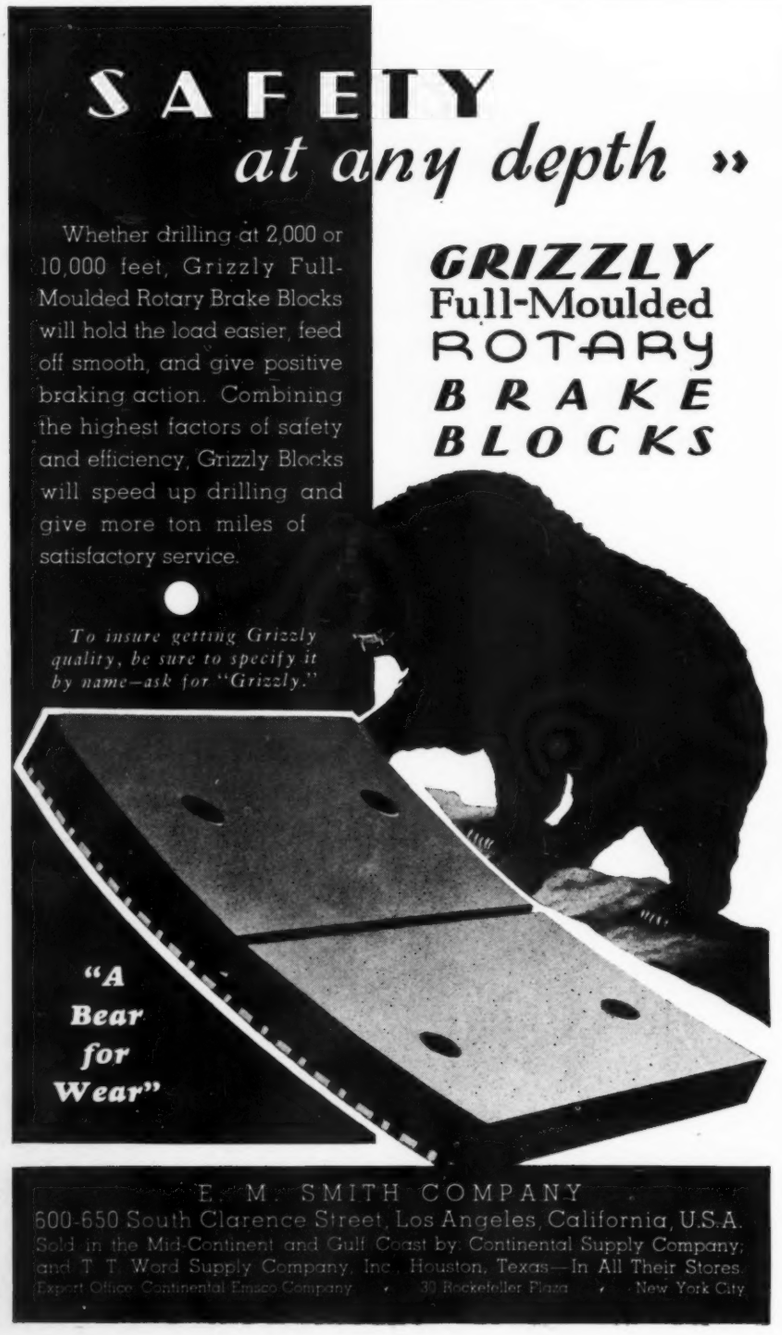
Prolific Producers. The outstanding producer of west-central Texas, in point of cumulative production, is The Texas Pacific Coal and Oil Company's No. 1 Norwood in the Ranger district of Eastland County with a total of 1,152,000 bbl. to its credit. Its initial production was 6300 bbl. of high-gravity oil per day on December 30, 1918, from a depth of 3383 ft. to 3412 feet. This well produced for more than 15 years.

In Stephens County, the same company's No. 7 Newell had produced 1,080,000 bbl. to December 1, 1932, from a total depth of 3384 feet. The original completion of this well was on November 27, 1921. Another million-barrel producer is Gulf Production Company's No. 2 Stoker in the same county.

Shallowest Area. The shallowest producing area in the West-Central Texas district is the "Shallow Cross Plains Pool," two miles southwest of Cross Plains in Callahan County. Production was found in 1925 from depths of 300 ft to 385 ft. in the Cisco formation. The initial gravity of the crude was 35 to 36 deg. A.P.I. Production is found mainly on sand lenses. In the same field, deeper production has been found in the Upper Strawn formation, which yields crude of 41 gravity at depths from 1200 ft. to 1300 feet. These productive sands are characterized by a short flush period, after which pumping must be resorted to.

Carter Pool. A small but prolific field was discovered in June, 1924, six miles north of Ranger in Stephens County by B. Carter. The discovery well was completed at a depth of 3571 ft. in the Lake Eastland horizon for an initial production of 350 bbl. of 40-gravity oil. The following year, a 3600-bbl. producer was completed at Barkley et al's No. 1 Pritchard. In all, 12 oil wells were completed and proved an area of 150 acres to be productive. The peak production was reached in May, 1925.

Ellenburger Production. What is regarded as the first commercial production in the Ellenburger lime, deepest pay zone in the west-central Texas district, was discovered on July 18, 1935, by Pitzer & West, Breckenridge operators, at their No. 1 G. T. DeLafosse, rank wildcat test in eastern Shackelford County. Initial production was rated as 200 bbl. of high-gravity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oil from 4453 ft. to 4457 ft. in lime, the top of which was found at 4435 feet. The well was improperly completed and was abandoned late in 1935. Humble Oil and Refining Company took over the block the same year because of the potentialities in the Ordovician Ellenburger.

Production Summary. To date 36 fields have been developed in 17 counties of west-central Texas. There are wildcatting activities in ten other counties. The summary of producing areas, arranged alphabetically by counties, is as follows:

BROWN: Cross Cut, Pioneer, Smith-Ellis, Brownwood, Fry.

CALLAHAN: Cross-Plains, Putnam.

COLEMAN: Goldsboro.

COMANCHE: Desdemona (several wells), Sipe Springs.

ERATH: X-Ray.

EASTLAND: Desdemona, Ranger.

FISHER: Rotan, Royston, Tidewater (1936).

HASKELL: ———

McCULLOCH: White.

McLENNAN: South Bosque Field.

PALO PINTO: Brazos, Strawn.

RUNNELS: McMillan.

SHACKELFORD: Bluff Creek, Delafoose, Cook, Moran, Sedgwick.

STEPHENS: Ibex, Ivan, Curry.

THROCKMORTON: Woodson.

YOUNG: Bunger, Graham, Herron, South Bend.

In addition, wildcatting has been active in a marginal territory including Nolan, Stonewall, Kent, Hamilton, Bell, Johnson, Hood, Mills, Tarrant, and Bosque counties.

PIPE LINES

Eight major pipe lines serve the West-Central Texas district. One of the major outlets for the region is the Humble Pipe Line Company's trunk line extending from Houston to Comyn, which handles the output from the Fambrough and Swastika stations on gathering lines extending as far north as the Brazos River. The Ranger area of Eastland and Stephens counties finds a major outlet through the Gulf Pipe Line Company's trunk line extending eastward from Ranger to Weatherford, thence to Lufkin, Beaumont, and Port Arthur. Another important outlet for the Ranger area is the Stanolind Pipe Line Company's 8-in. line extending from Eastland County northeast through Palo Pinto County to the Graford station, from which point it joins the 8-in. and 10-in. trunk line extending to the Gulf Coast via Lakenon, Easterly, Singleton, Hufsmith, and Aldine Junction stations

One of the most extensive gathering systems in this district is that of the Texas Pipe Line Company originating on the south at its Fry station near Brownwood where 4-in. lines take the crude northeast to Browning and Ranger. Crude gathered from southern Young County at its South Bend and Bunger stations is taken through 4-in. lines to Breckenridge and to Ranger. An 8-in. trunk line of the Texas Pipe Line Company handles shipments to its West Dallas refinery via Millsap and Fort Worth.

REFINING

The largest refinery in West-Central Texas is the 1400-bbl. plant of the Octane company in Callahan County. There are numerous small plants throughout the region, including many in Jack County.

NATURAL GASOLINE

The center of natural gasoline plant operation in West-Central Texas is the Eastland and Stephens County locality where 34 gasoline plants now are in operation. The total monthly combined output is 5,800,000 gal. of gasoline.

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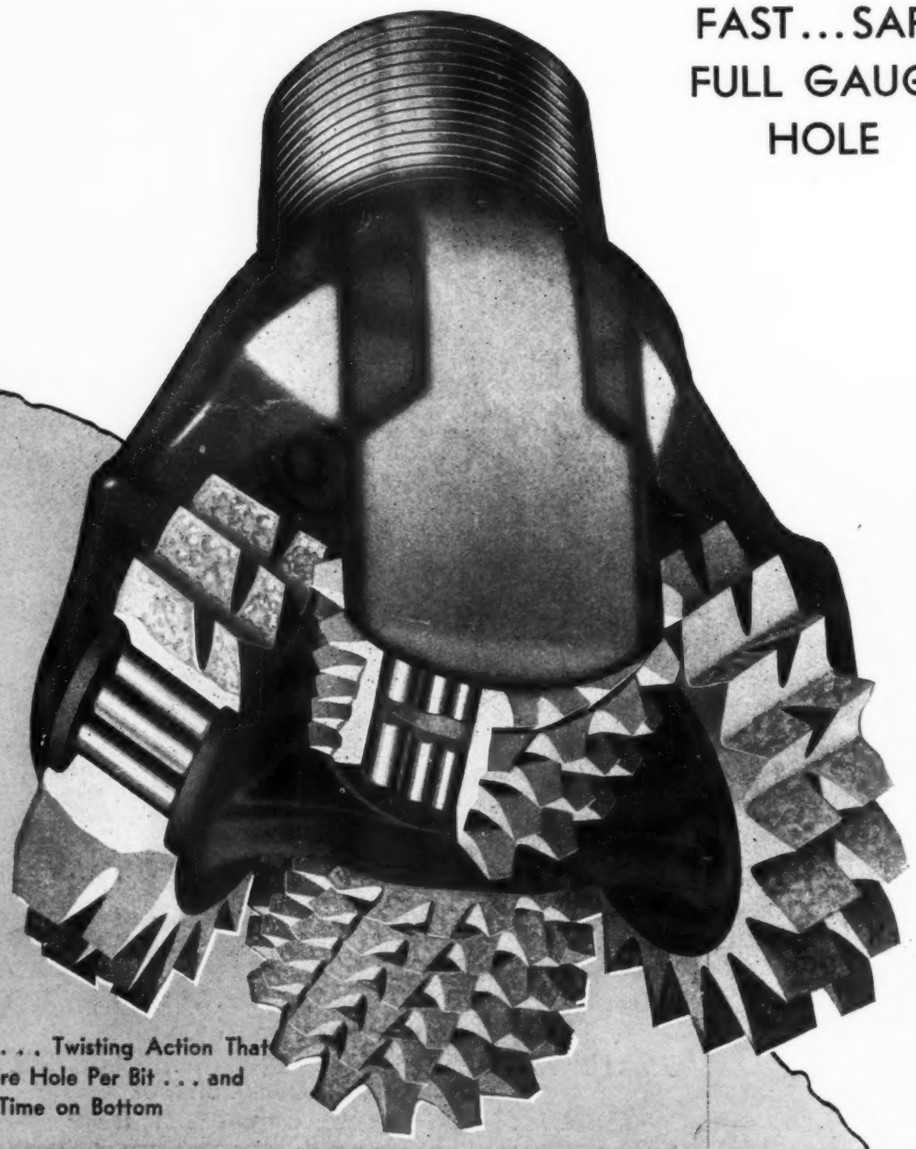

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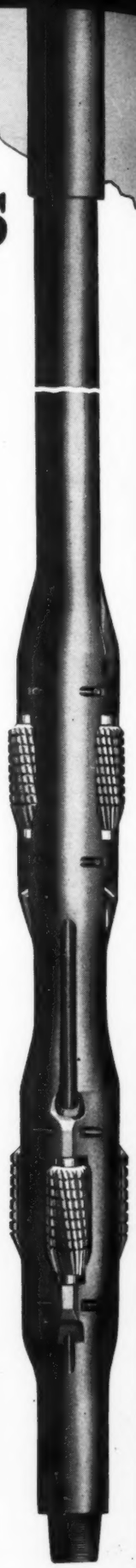

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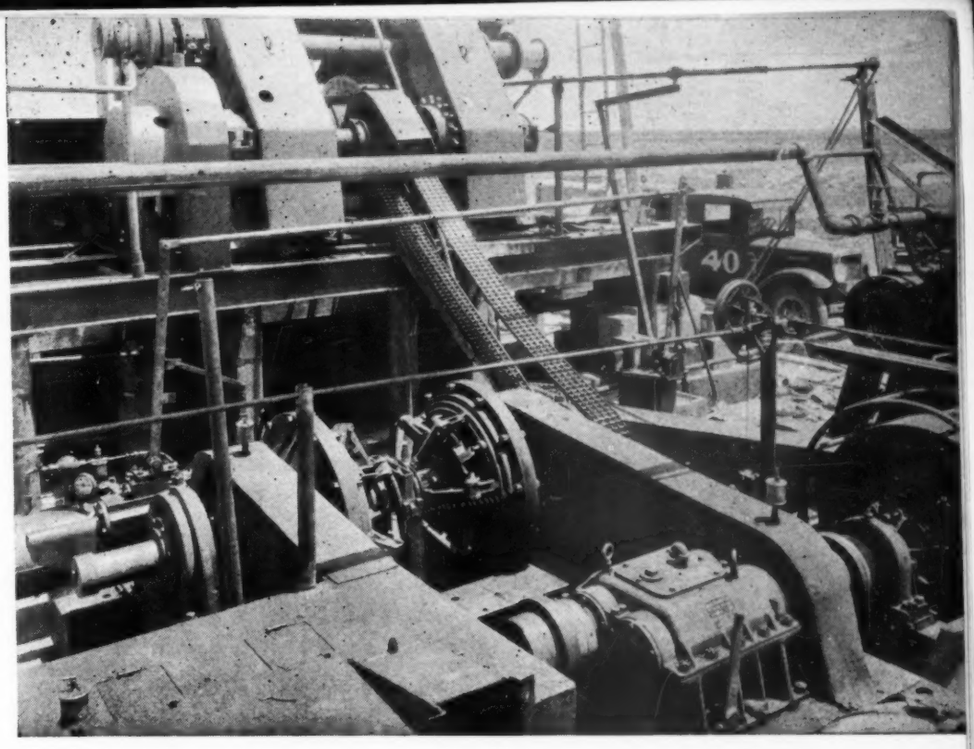
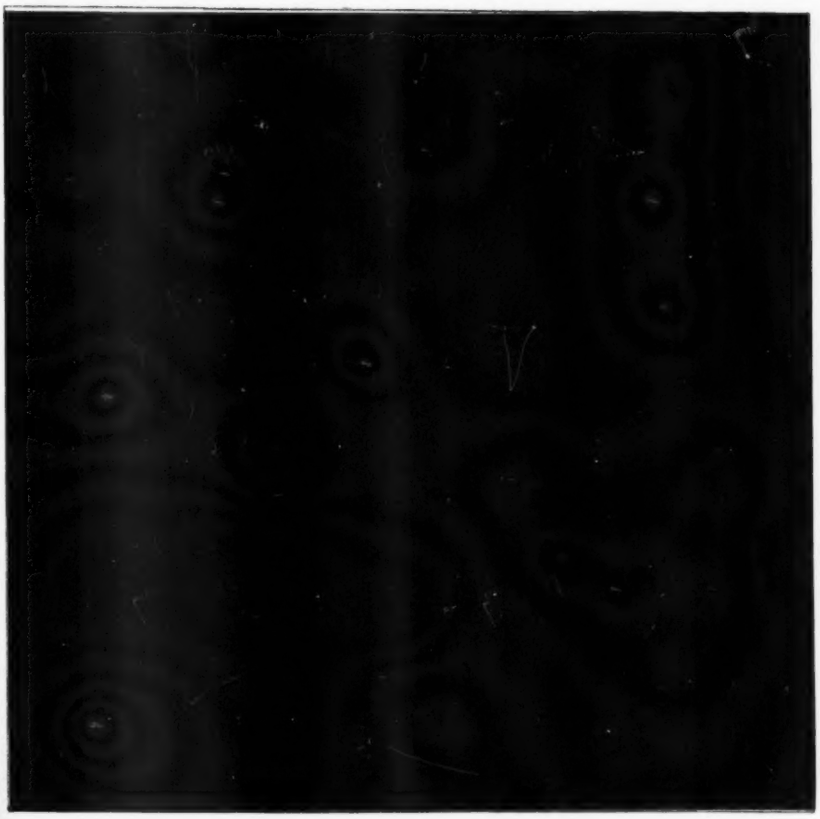


An unusual view of a heavy Sheldon transmission on a West Texas Diesel rotary rig. Picture taken during "rigging up." Note the heavy quadruple width precision roller chain driving the drawworks jackshaft from the forward and reverse clutch

Review of Petroleum Development in West Texas

PRODUCTION

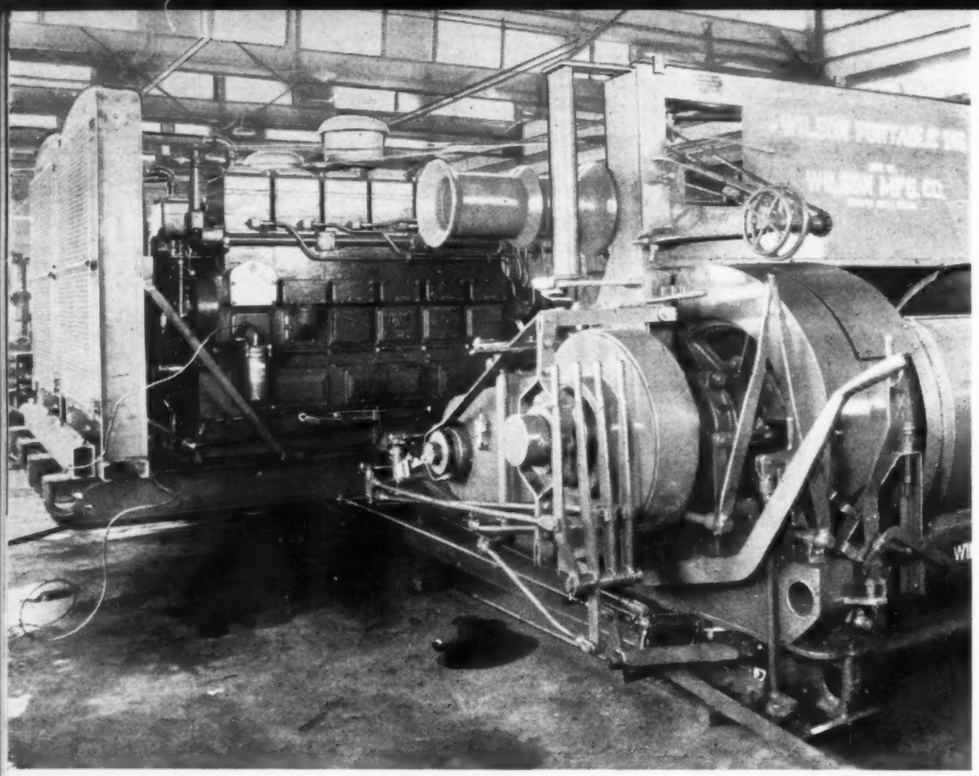
INTRODUCTION. One of the largest and most important oil regions of Texas is the Permian Basin comprising West Texas and southeastern New Mexico. In this huge bowl has been found production to depths of 9100 feet. On its south rim is situated the world's most prolific shallow field where at least 21 wells have produced more than 1,000,000 bbl. each from a depth of approximately 1200 feet. On the east flank of the basin the most highly productive well in the United States is situated—The Texas Company's No. 11 Cowden and Anderson (Church-Fields-McElroy field of Crane-Upton counties), which has produced in excess of 6,000,000 bbl. of oil. The highest gauged production in the United States is found at Yates at the Mid-Kansas Oil and Gas Company's No. "A"-30 Yates, which produced at the rate of 8528 bbl. per hour, or 204,681 bbl. per day on official production test.



Map showing West Texas oil fields. (Courtesy Weekly Oil Report, Midland, Texas)

Like so many discoveries of the early days of the oil industry in Texas, chance played a large part in transforming overnight this Cow County to a veritable Oil Klondike. The Midas touch of the "Wildcatter" spouted a shower of wealth that has not appreciably lessened; as spectacular booms continue to reward the search for new trends and deeper pays.

Big Lake. A former army officer is responsible for the opening of the discovery pool—Big Lake. He had read a geological report on West Texas and decided to drill out in the arid



Two 200 hp. Cummins cold-starting full Diesel engines powering a Wilson giant model rig operated by Geo. P. Livermore, drilling contractor, drilling for Navarro Oil Company near Kermit, Texas.

country. He leased University Land in southwestern Reagan County and with another army officer organized the Texon Oil and Land Company. The excellent salesmanship abilities of the latter proved to good advantage in obtaining adequate finances for the first test well. In May, 1923, the discovery well came in from less than 3000 ft., and just at that time, in melodramatic fashion, the Orient Railroad was on the verge of abandonment.

Since its discovery in May, 1923, the Big Lake field had produced from the shallow Permian zones 50,535,456 bbl. to December 31, 1931, and from 3390 proven acres the recovery at this date was 14,900 bbl. per acre. With the discovery of Ordovician production, 12 oil wells have proven 750 acres to be productive in the 8500-ft. to 9100-ft. pay, the cumulative production from which is in excess of 20,000,000 bbl. of 44- to 60-gravity oil. The Ordovician discovery was Group One Oil Corporation's No. 1-B University, completed November 30, 1928, at 8520 feet.

In the Ordovician pay at Big Lake, four wells have produced more than 1,000,000 bbl. each. The leader was Group One Oil Corporation's (now subsidiary of Continental Oil Company) No. 1-B University, which had produced 2,660,000 bbl. up to January 1, 1932. Next was the same company's No. 4-B University with a total cumulative output of 2,375,000 bbl. to the same date. Big Lake Oil Company has

PRODUCTION SUMMARY

WEST TEXAS PRODUCING AREAS

Pool	County	Date of Discovery	Depth of Pay Sand	Gravity of Oil —Deg. A.P.I.	Cumulative Production in Bbl.
Church-Fields-McElroy	Crane-Upton	March, 1926	2725	32	95,877,322*
Waddell	Crane	Aug., 1927	2400		40,868[1]
World-Powell-Grayson	Crockett-Reagan	1925			4,575,559[1]
Penn-Judkins	Ector	Oct., 1929	3700	34.2	13,017,670*
Connell	Ector	Oct., 1926	3075	29.0	
Stanolind	Ector	Sept., 1930	4130	.....	
Chalk	Howard	April, 1925	1300-3000	31.7	65,969,026*
Robert Settles	Howard	Oct., 1927	3000	26.8	
World-McDowell	Glasscock	May, 1929	2385	27.7	
Mertzon (Tankersley)	Irion	July, 1929	1336	37.0	
Wheat	Loving	Sept., 1925	4212	40.2	5,081,726[1]
Westbrook	Mitchell	Oct., 1921		28.0	7,550,943*
Pecos Valley	Pecos	Nov., 1928	1620	31.0	370,365[1]
Masterson	Pecos	Nov., 1929	1438	37.0	21,196[1]
Phillips-Pryor	Pecos	May, 1929	1345	22.0	22,505[1]
Taylor-Link	Pecos	June, 1920	1613	32.0	3,431,628[1]
Yates	Pecos	Oct., 1926	1291	30.0	206,864,264*
Toborg	Pecos		315	22.0	2,434,195[1]
Big Lake	Reagan	May, 1923	2900-8900	60.0	82,000,000*
Skelly-Grayson	Reagan	Feb., 1928		34.0	181,859
McCamey-Taylor	Upton	Sept., 1924		25.-30.0	26,501,617[1]
Bennett	Ward	Sept., 1929	2599	32.0	
Grand Falls (Shipley)	Ward	Nov., 1928	2480	31.0	
Hayzlett	Ward				
O'Brien-Hutchings	Ward	April, 1929	2694	38.9	
Hendrick	Winkler	Nov., 1926	2460	30.0	183,428,580*
Llano	Winkler	.....	2942	32.0	
Sealy	Winkler	Sept., 1929		36.5	
World	Crockett	May, 1925		29.7	
Deep-Rock	Andrews	Dec., 1929	4345	30.0	219,234*
Fuhrman	Andrews	Oct., 1930	4262	24.0	
Means	Andrews				22,193[1]

*To January 1 1936. [1]To January 1, 1935

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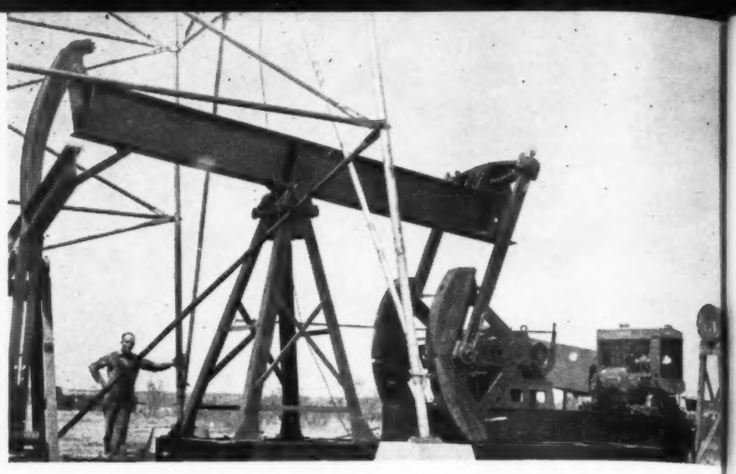


Twin-crank pumping unit driven by gasoline engine. The unit is shown making a "potential" test on an Iron Mountain Oil Company well near Big Spring. Note the "Oilwell" pumping jack at the extreme left. This jack is used for regular pumping of this well

two wells that have produced approximately 1,250,000 bbl. each, their No. 4-C and No. 5-C University.

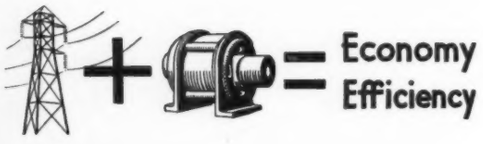
McCamey-Taylor. One of the larger Permian Basin fields was opened at McCamey in Upton County in September, 1924. By the end of 1931, a cumulative production of 21,392,193 bbl. of oil had been produced. The crude proved to be of comparatively low gravity, ranging from 25 to 30 deg. A.P.I. But other and larger fields carrying crude of higher gravity were in store, for at the time of this discovery the possibilities of the Permian Basin had just been touched.

Chalk. A field with double the output of the McCamey-Taylor field was opened in the chalk area in Howard County in April of 1925. Production was found from as shallow as 1300 ft. to depths of 3000 feet. Cumulative production to the first of 1932 was 42,241,232 barrels. The crude tested 31.7 deg. A.P.I.

Yates. What proved to be the world's largest shallow oil field was opened on the Yates ranch in eastern Pecos County in October, 1926, by the Mid-Kansas Oil and Gas Company, now the Marathon Oil Company, producing subsidiary of the Ohio Oil Company. More than 19,000 acres were proven by December 31, 1932, at which time a recovery of approximately 8500 bbl. per acre was indicated. Cumulative recovery at the time reached 161,150,287 barrels. This field is one of the most spectacular of West Texas, since 21 oil wells have produced in excess of 1,000,000 bbl. of crude per well from a depth of only 1125 ft. to 1850 feet. Production was found in the Permian lime; the porosity is the result of leaching. The principal source of pressure is the hydrostatic head. This field holds the record for having the well with the highest daily potential in the United States—Mid-Kansas "A"-30 Yates, which flowed at the rate of 204,681 bbl. per day. One of the largest wells in the field (from the standpoint of cumulative production) is the Mid-Kansas and Transcontinental Oil Companies' No. 5-D Yates. This well had produced 4,620,000 bbl. of oil by the end of 1931, at which time it was still producing at a relatively high rate. An ultimate yield of 40,000 bbl. per acre is indicated by engineering estimates that have been made.

Seepage Oil at Yates. Possibly the shallowest oil field in Texas to produce

The Most Obvious Equation in the Petroleum Industry:



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seepage oil is that in the Yates field of Pecos County, the oil migrating from the 1200-ft. regular pay horizon. Since 1928, when the oil seeps were first noticed along the Pecos River, a total of three and one-half million bbl. has been produced. Two million barrels have been obtained from 60 shallow wells ranging in depth from 10 ft. to 90 ft., and an additional one and a half million barrels cumulative production from at least 20 open pits. The company most active in recovery of seepage oil is the Continental Oil Company. Miniature pumping outfits, handled electrically, are pumped from a small central power within a radius of 100 feet. The peak of seepage production was reached in July, 1929.

Church-Fields-McElroy. One of the major developments in the Permian Basin was discovered in March, 1926, in Crane and Upton Counties. More than 80,000,000 bbl. of oil had been produced by January 1, 1932, from an average depth of 2725 feet. The most productive oil well in the United States was found in this field at The Texas Company's No. 11 Cowden-Anderson. This well has produced more than 6,000,000 bbl. of crude since its discovery on August 9, 1927. Its initial production was 8200 bbl. of pipe line oil per day from 2825 ft. to 2840 feet. Since December, 1932, the well has been under proration and still produces more than 200 bbl. daily.

Hendrick. Possibly the largest producing field in West Texas from the standpoint of cumulative recovery, is the Hendrick field in Winkler County, discovered in September, 1926. Although in extent its 11,150 proven acres is smaller by 7850 acres than that of the Yates pool of Pecos county, yet it had produced 165,288,266 bbl. to the first of 1933, at which time 14,800 bbl. per acre was the total recorded recovery. The average depth of production is 2460 feet.

Ten producing wells in the Hendrick field have produced in excess of 1,000,000 bbl. each. The outstanding producer, in cumulative production, was Cranfill-Reynolds Company's No. 1-C Ida Hendrick, which had produced more than 1,800,000 bbl. to December 30, 1930, the date of its abandonment. It was completed on March 1, 1928, for an initial production estimated at 50,000 bbl. per day from 2718 ft. to 2733 ft. in lime. Other spectacular producers in this field were Southern Crude Oil Purchasing Company's (now Stanolind Oil and Gas Company) No. 1 Hendrick T-88-B, which had produced 1,625,000 bbl.; Republic Production Company's No. 1 Hunter & Grisham, which showed a recovery of 1,600,000 bbl.; Humble Oil and Refining Company's No. 4 Hunter & Grisham, with a total recovery of 1,100,000 bbl.; and Collett and Atlantic's No. F-2 Hendrick with an output to date of more than 1,225,000 barrels.

In northwestern Upton County, in the Permian Basin of West Texas, another world's record, for the deepest well drilled in the history of the oil

NATURAL GASOLINE PLANTS

Company	Size of Plant	County	Capacity
Humble Oil & Refining Company	Yates	Pecos	14,000,000 c. f.
Signal Gas	Big Lake	Reagan	25,000,000 c. f.
Big Lake	Big Lake	Reagan	50,000,000 c. f.
Phillips Petroleum Company	Odessa	Ector	
Phillips Petroleum Company	Church-Fields	Upton	

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There is no mystery of how a bank makes its living. We rent out money, just as a landlord rents his property. And like him, we're interested in keeping all our houses occupied. In other words, we'd like to see every available dollar rented out in sound loans to individuals and companies for the betterment of their business.

•

The National Bank of Tulsa has made 1881 new loans in 1936—a total of $11,205,522.29 rented out to individuals and corporations. We'd like to do business with you, too.

NATIONAL
BANK OF TULSA

The Oil Bank of America

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

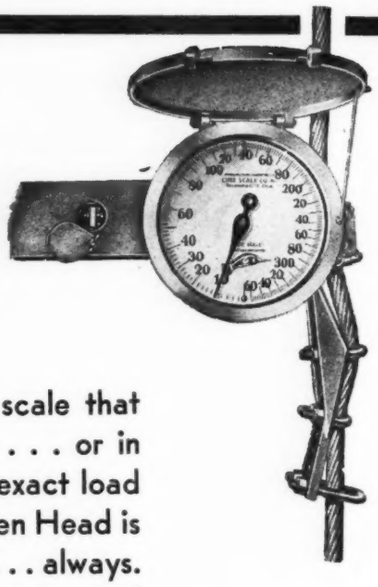
REFINERIES

Refiner	Size of Plant	Capacity
Burford Refining Company	Pecos	2,500 Bbl.
Cosden Refining Company	Big Spring	
Col-Tex Refining Company	Colorado	10,000 Bbl.
Great West Refining Company	Big Spring	
Continental Refining Company	Pyote	
Wickett Refining Company	Wickett	2,500 Bbl.
Signal Refining Company	Santa Rita	
Howard County Refining Company	Big Spring	
Mid-Tex Refining Company	Midland	2,500 Bbl.
Big Spring Refining Company	Big Spring	3,500 Bbl.
J. S. Cosden	Big Spring	15,000 Bbl.
Pasotex	El Paso	17,000 Bbl.
Rio Grande	El Paso	2,500 Bbl.
The Texas Company	El Paso	3,000 Bbl.
Humble Oil & Refining Company	Yates	14,000 Bbl.
Humble Oil & Refining Company	McCamey	

"I Can't Tell a Lie"

. . . . *Says*

GREEN HEAD LINE SCALE



You wouldn't want a line scale that couldn't tell you the truth . . . or in other words, give you the exact load on the line at all times. Green Head is accurate and dependable . . . always. Rugged Construction, easy to read and easy to install. No fluid to leak; no parts to get out of order. Buy a Green Head and be safe!

Distributed by

GREEN HEAD

BIT AND SUPPLY CO.

OKLAHOMA CITY, OKLA.

Scott, Louisiana Houston, Texas Odessa, Texas

industry, was established in 1934. This well, the Gulf Production Company's No. 103 J. T. McElroy in the shallow McElroy Permain lime pool, reached a depth of 11,410 ft., surpassing the depth of the previous record-holder, General Petroleum Corporation's No. 1 Berry in the North Belridge pool of California. The Gulf well was drilled to a total depth of 12,786 ft. before being plugged back and completed in the shallow Permian lime horizon at 3000 feet.

Yoakum County Discovery. The most recent West Texas county to join the procession of productive oil counties is Yoakum, the farthest north in the Permian Basin. The discovery well was Honolulu Oil Corporation and Cascade Oil Company's No. 1 L. P. Bennett in section 678, Block D, John H. Gibson survey, which flowed 15 bbl. of oil per hour on April 22, 1936, during a four-hour test.

Ten Counties Active. At this writing West Texas activity amounts to 39 locations per week for a ten-county area. Leading in locations are Upton and Jones with seven each; Pecos and Winkler with five each; Crane, Ward, Glasscock, and Howard with three each; and Ector and Andrews with one each.

Proven Reserves. The outstanding proven reserve of West Texas is the Yates field of Pecos County, which has an estimated ultimate recovery of 335,000,000 bbl., which, considering a production to date of 168,000,000 bbl., leaves a reserve of 167,000,000 barrels. The Church and Fields pool and the Gulf-McElroy pools together have an estimated ultimate recovery of 325,000,000 bbl., of which 85,000,000 bbl. have been produced. Next in importance in reserves in West Texas is the Hendrick field, which will yet produce 30,000,000 bbl. in addition to the 169,000,000 bbl. it has produced to date. McCamey has produced 25,000,000 bbl. and has an additional reserve of 10,000,000 barrels.

DEEPER PAY POSSIBILITIES

Ordovician. Up to 1935, the deeper production in Texas was found in the Permian Basin. Ordovician production in West Texas was first discovered in the Big Lake field of southwestern Reagan County after an oil well in the Pennsylvanian was drilled deeper to the 8700-9100-ft. zones. To date, 12 oil wells have been completed in this field from the Ordovician, which has produced more than 20,000,000 bbl. from less than 80 acres. The gravity of the crude is 44- to 60-deg.

A.P.I. Demand for this crude is based primarily upon the excellent lube oil stock that it yields.

Waddell. The first successful Ordovician strike since Big Lake was made in February, 1936, in the Waddell area of Crane County. Gulf Oil Corporation's No. 1 W. N. Waddell, had an initial output of 70 bbl. of 34.7-gravity oil per day on the pump from the Simpson lime. The pay sand was found from 5680 ft. to 6317 feet. Late in March its output had increased to 95 bbl. per day by flowing the well with the aid of valves.

Love Ranch Area. Additional potential Ordovician production was discovered in the Edwards plateau district when Evans & Gant's No. 2 Love on the Love ranch in southwestern Kerr County in January, 1932, filled up with oil of 31.5 deg. A.P.I. gravity from a sand in the Ellenburger lime, the lime having been topped at 5600 feet.

Pennsylvanian Possibilities. One of the major sources of future reserves yet to be developed in the Permian Basin of West Texas is the Pennsylvanian production. Such a statement is based on the finding of commercial production in the first deep test drilled in the Big Lake field of Reagan County, the commercial gas production near Eldorado in Schleicher County, and the commercial production recorded at Evans & Gant's No. 2 Love in Kerr County, which showed 2,000,000 cu. ft. of gas per day from 3035 ft. to 3080 ft. in the Pennsylvanian formations. During 1936, another Schleicher County wildcat, Magnus Oil Company's No. 1 Judkins & Spencer, in the center of the south west quarter of section 4, block V-28, showed gas sand from 4955 ft. to 4958 ft. in the Pennsylvanian formations.

Oil Mine. One of the two commercial oil mines in the United States is "West of the Pecos" in the Permian Basin, 20 miles north of Toyah. At this place there are two 20-ft. drifts which run to the bottom of a 105-ft. shaft. The "mine" produces about four bbl. of crude per day, which brings a market price as high as $12.50 per barrel. The oil is used in its natural state by the Texas and Pacific Railroad for journal oil. This crude has not been found in any other place in the vicinity, even though exploration has been extensive.

Field Summary. A field summary at this time shows the following producing areas (arranged alphabetically by counties), comprising 53 fields in

TRUNK PIPE LINES

Pipe Line Company	Point of Origin	Point of Destination	Size (Inches)
The Texas Pipe Line Company		Houston	12
Shell Pipe Line Company		Houston	10
Pasotex		El Paso	8
Magnolia Pipe Line Company		De Leon	8
Humble Pipe Line Company		San Angelo	two—8
Atlantic Pipe Line Company		Houston	10
Gulf Pipe Line Company		Ranger	10
Auxiliary Pipe Lines			
Wickett Refining Company	Grand Falls	Wickett	4

'For Sixty Out of The Seventy Years

1st NATIONAL

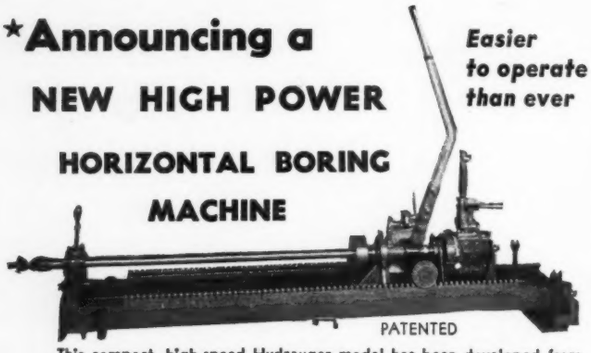
For seventy years out of the Centennial century oil has been known to exist in Texas. For sixty out of these seventy years this bank has served Texas . . . and has played an increasingly vital part in the financing of the oil industry.

Today the First National in Dallas has approximately twelve million dollars in oil loans . . . an evidence of the fact that this bank is decidedly oil-minded. The preference shown by an ever-increasing number of the oil fraternity makes this bank . . . in oil as in other lines . . . The Southwest's Leading Bank.

FIRST NATIONAL BANK
IN DALLAS MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

***Announcing a NEW HIGH POWER HORIZONTAL BORING MACHINE**

Easier to operate than ever



PATENTED

This compact, high-speed Hydrauger model has been developed from many years' experience in building horizontal boring machines. It embodies features of the larger sized Hydraugers plus other important refinements.

FEATURES

- 5-horsepower airmotor gives 50% faster boring.
- New 4'8" boring bar sections easier to handle.
- Extra strong hi-tensile alloy boring bar joints.
- New shaped cutters both cut and undercut at the same time for faster boring.
- Short, rigid frame requires less ditching for setting-up.
- Higher speed boring insures greater accuracy.
- Bores holes 2½" to 14½".

It is a high-power, medium priced unit for rapid boring of horizontal holes up to 14½" in diameter.

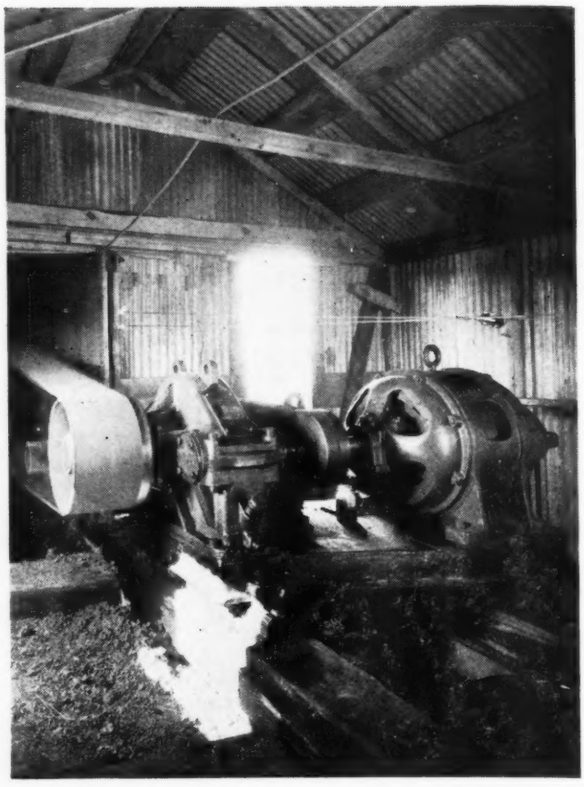
Important advantages are: greater ease of setting-up and boring; straighter boring; lowest cost and fastest installation of underground piping; and minimum investment.

Hydrauger units are indispensable when installing wrapped or coated pipes. They have been widely used to prevent pavement cutting, ditching, traffic interruption, and destruction of lawns or gardens when installing horizontal piping. Installation costs are often reduced 90%. In many instances where pavement cutting permits were refused the Hydrauger was the only possible solution. Invariably a Hydrauger will pay for itself within one year and often on a single job.

Ask for full details of the new Hydrauger Model 2A-2X.

HYDRAUGER CORPORATION, LTD.
116 New Montgomery St., San Francisco

HYDRAUGER
"The Mechanical Gopher"



An oil well in Crane County, West Texas, being pumped by a motor-driven unit

How Much Is It Worth?

This ball and seat may be catalogued at $3.07 . . . but to the operator in whose well it is lost it may represent a cost of several thousands of dollars.

The history of this ball and seat is typical of dozens of other objects that, when lost, become exceedingly costly. Due to certain well conditions the top of a double cage pump had unscrewed, leaving this ball and seat plugging the top of the barrel so that a spear could not be used. Tubing could not be pulled because it had been set on a packer deep in the drilling mud when the well was brought in. The fish and the standing valve at the bottom of the pump plugged the tubing so that pressure could not be forced through the tubing to equalize the pressure on each side of the packer. A 2⅛" O.D. Cavins Bailer and Junk Basket was called into use and run inside the tubing (2⅞" O.D.). As in many cases, the fish was recovered on the first run—less than an hour being consumed for the entire job.

When there is a fishing job to be done—call for the Cavins—it may save you thousands of dollars.

Write for descriptive Bulletin No. 36, giving complete details

THE CAVINS COMPANY

2853 Cherry Ave. Phone 414-14 Long Beach, Calif.

Cable Address: "Cavins, Long Beach" Foreign Representative: R. J. Eiche

Bakersfield, Calif. Taft, Calif. Goleta, Calif. Santa Paula, Calif. Houston, Texas Kilgore, Texas Pampa, Texas. Oklahoma City, Okla. Wichita, Kansas Lyons, Kansas

15 counties. Ector County alone has ten pools to its credit, while eight pools have been discovered to date in Pecos County.

Andrews: Deep Rock, Fuhrman, Means, Parker.

Crane: Church, McElroy, Sand Hills, Waddell.

Crockett: Todd, World-Powell.

Ector: Addis, Connell, North Cowden, Davidson-Cole, Goldsmith, Holt, Johnson, Judkins, Penn, Scharbauer.

Glasscock: Settles.

Howard: Chalk, Coahoma, Howard-Glasscock.

Irion: Mertzon.

Loving: Wheat.

Mitchell: Iatan, Westbrook.

Pecos: Netterville, Pecos Valley Masterson, Rowan-Tong, White and Baker, Taylor-Link, McKenzie, Yates.

Reagan: Big Lake, Skelly-Grayson.

Upton: Hurdle, Sherk, McCamey.

Ward: Grand Falls, Monroe, O'Brien, Shipley, South Ward.

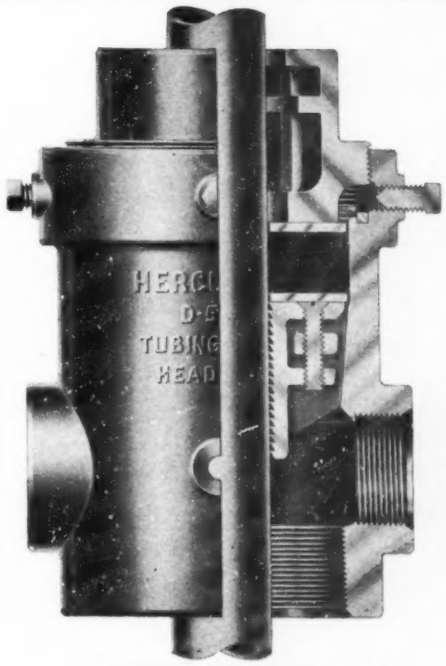
Winkler: Brown and Altman, Hendrick, Halley, Kermit, Keystone, Scarborough, Sealy.

Yoakum: Bennett.

Proration Restrictions. The latest proration schedule at this writing for the West Texas district shows a restriction to 158,563 bbl. per day as follows:

Bennett	150
Bashara	18
Brown-Altman	1,389
Church-Fields	6,960
North Cowden	6,350
South Cowden	401
Crane-Cowden	572
Deep Rock	443
Dobbs	100
Edwards	16
Emperor	715
Foster	180
Fuhrmans	850
Goldsmith	651
Gulf-McElroy	4,640
Halley	149
Harper	94
Hendrick	13,815
Howard-Glasscock	20,000
Iatan-Howard	8,100
Johnson	30
Keyes	100

40-hp. Fairbanks-Morse slow speed gas engine pumping a well through Falk gear unit at Big Spring, Texas



HERCULES "Type D-5" Cast Steel Tubing Head with Slips

"OVERHEAD-PACKED" TUBING HEADS

Offer REAL Advantages

The HERCULES "Type D-5" Tubing Head was designed to give the operator a one-piece, full-opening head that would assure maximum efficiency in connecting up a well.

Check these important features:

- "OVERHEAD PACKING" *above* the slips permits repacking and adjustment of pressure on packing *without disturbing well connections.*
- OIL-SAVER TOP accommodates wire line oil saver or tubing spider.
- SLIPS OF SPECIAL DESIGN are hinged together in one unit and are easily adjusted by convenient latch.
- COMPACT DESIGN with few parts makes installation simple and quick.

The HERCULES "Type D-5" Tubing Head is made of high-grade electric cast steel and is tested for 2,000 pounds. For sale at your supply store, or write today for descriptive Bulletin No. 14.

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Phone 2-7028

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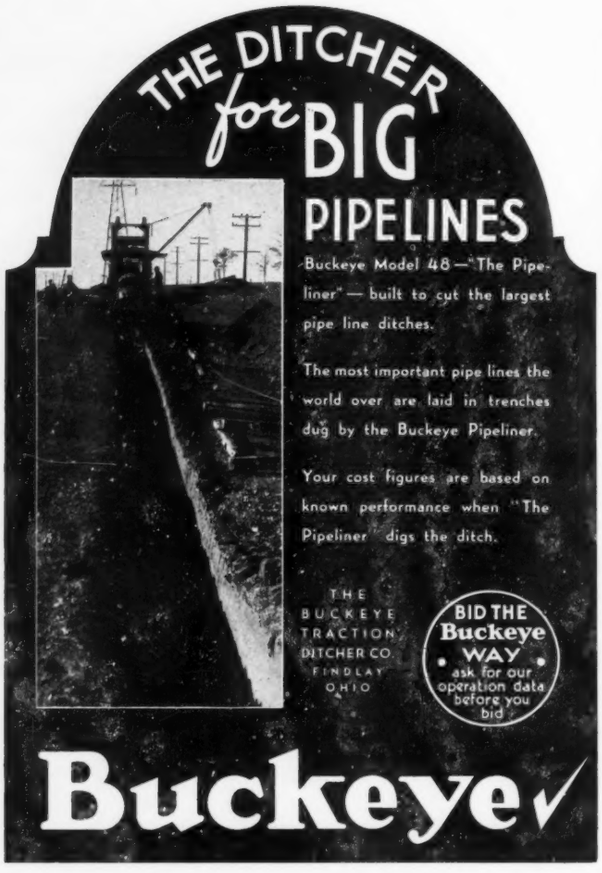
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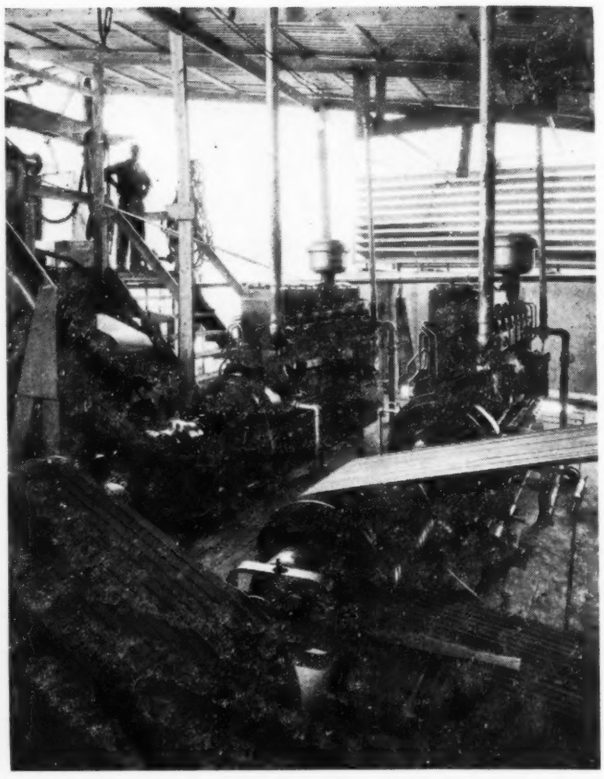
Buckeye Model 48—"The Pipeliner"—built to cut the largest pipe line ditches.
The most important pipe lines the world over are laid in trenches dug by the Buckeye Pipeliner.
Your cost figures are based on known performance when "The Pipeliner" digs the ditch.
THE BUCKEYE TRACTION DITCHER CO. FINDLAY OHIO
BID THE Buckeye WAY
ask for our operation data before you bid
Buckeye



Two 200-hp. Cummins cold starting full Diesel engines such as used on drilling rigs in Texas fields

Accurate and Easy to Read Because . . .

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INTERCHANGEABLE INCLINATION UNITS

provide the largest reading scale possible for each and every condition encountered . . . with ONLY ONE INSTRUMENT REQUIRED.

An Exclusive feature of the

ANDERSON

PHOTO-RECORD

MAGNETIC SINGLE-SHOT SURVEY INSTRUMENT

This instrument measures both INCLINATION and DIRECTION of open hole in drilling wells. The reading is photographed on metal-rimmed Record Discs which are developed on the derrick floor and ready for direct reading within four minutes after the instrument comes out of the well. No knowledge of photography or mathematics is required.

Send for Bulletin 11A

ALEXANDER ANDERSON, Inc.

SURVEYORS OF OIL WELLS SINCE 1924

FULLERTON CALIFORNIA U. S. A.

Keystone	1,368
Leck	500
Masterson	400
Means	1,466
McClintic	932
McKinzie	8
Monroe	25
Netterville	29
Northwest	33
Parker	45
Pecos Valley	432
Penwell	6,740
Richards	10
Sand Hills	240
Sand Hills (Ordovician)	60
Sayre	4,627
Scarborough	1,885
Sealey	750
Shipley	1,581
Toborg	2,351
Taylor-Link	1,407
Waddell	2,032
Walker	10
North Ward	8,075
South Ward	16,170
Westbrook	835
Wheat	1,800
White-Baker	3
Yates	38,856

Regional Geology. The Permian Basin comprises portions of Texas, Panhandle Oklahoma, and Western Kansas. In addition, it is underlain by a Pennsylvanian and Ordovician basin. On the periphery of the basin, reef limestones form

the structure. Closures are as much as 125 ft. in the shallow Permian lime pay and as much as 300 ft. in the Church-Fields-McElroy. Truncated, faulted structures account for accumulation in the Ordovician at Big Lake in Reagan County, Waddell, in Crane County, Todd in Crockett County (potential field). Oolitic lime production has been found in the shallow Big Lake field and in the Chalk pool. Dolomitization is a major cause of porosity in the Big Lime (Permian), five different pay zones having been found in a single field within a thickness of 1800 feet.

Built from Oil Wealth. Discovery of oil in 1923 on University-owned land in Reagan County, West Texas, lifted the University of Texas at Austin from the financial difficulties that early characterized its existence, until today it has become one of the richest universities in the nation. More than $21,500,000 of oil wealth flowed from the West Texas holdings of the University during the 12-year period from 1923 to 1935. Its holdings are in Crane, Upton, Crockett, Reagan, Glasscock, and other counties in the heart of the basin.

PIPE LINES

Among the numerous pipe lines that serve the West Texas or Permian Basin district, at least four major lines are trunk outlets to the Gulf Coast. A 10-in. line of the Texas Pipe Line Company originating from the Hendrick pool in Winkler County extends to the Crane pool in Upton-Crane counties from which point a 12-in. trunk line extends to its Houston refinery via Iraan (serving the Yates pool), Sonora in Crockett County, Junction, Segovia, Fredericksburg, San Marcos, Rosanky, New Ulm, and Brookshire. The line also handles shipments from the Lea County oil pools in southeastern New Mexico through 4-in., 6-in., and 10-in. lines extending southward to the Wink station.

The Gulf Pipe Line Company's trunk line, originating at Wink and at Rankin, extends eastward from Midland, which is a converging point, to Ranger and to Houston, via Weatherford, Grandview, Mexia, Elkhart, Lufkin, and Sour Lake.

The Humble Pipe Line Company's trunk line originates at Winkler where it receives oil from the Stanolind. From Hobbs in Lea County, southeastern New Mexico, a 65-mile 8-in. line extends to the Winkler station. Eastward the line comprises 8-in. and 10-in. lines to Kemper where it receives crude from the Reagan County Purchasing Company. At Kemper an 8-in. feeder line handles the Big Spring area cutput. At this same station is the terminal for the 32-mile 8-in. line from the Yates-Pecos pool. From Kemper southeast the trunk comprises parallel 10-in. lines and 12-in. line to its Ingleside refinery via Lytle, Whitsett, and Skidmore. At Lytle, enroute, 18 miles of 4-in. feeder line extends to its San Antonio refinery.

The Atlantic Pipe Line Company's trunk line system originating in Ward County comprises a 6-in. and 8-in. feeder line extending to Winkler, from which point it extends northeastward to Midland where it meets the company's 8-in. feeder line from Hobbs. From Midland a 10-in. trunk line extends east and southeast to Atreco, the pipe line terminal in Orange County in Coastal Texas.

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WATER CANS & COOLERS
GOTT Water Coolers are the convenient way to keep drinking water handy to the worker, protect it from impurities. Their exclusive construction keeps water cool for long periods. Snug fitting large removable top, handy non-leaking push button faucet. GOTT Water Cans for handy field use.
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KEEP PURE DRINKING WATER ALWAYS HANDY

Look for the Arm-and-Hammer

ARMSTRONG BROS.

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Reversible Jaw Tongs
Back-Up Tongs
Break-Out Tongs

Improved designs give these tongs greater strength and handiness. *Jaws* are drop forged from special steel; are heat treated, hardened and tested for wearing qualities. *Chains* are proof-tested to ⅔ catalog strength (3,600 to 40,000 lb.) *Handles*, forged from high carbon steel, have both stiffness and "spring." Drop forged Chrome-Nickel *Shackel*. Hardened *Bolt*. No finer tongs made. All sizes.

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AND LONG BEACH, CALIFORNIA
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The new JENSEN Unit is heavier, finer than ever before. The first cost is low. The unit is easy to install. It is completely weatherproof—no house needed. It is readily moved back when the well needs to be serviced. It is as thoroughly dependable as good equipment should be.

We have a unique policy regarding JENSEN pumping equipment. We don't want your business unless we can save you money and increase the efficiency of your property.

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So if you don't know the JENSEN dealer in your field, write us a letter or shoot us a wire—at Coffeyville. It's just good business to bring your knowledge of pumping equipment up to date!

(You'll find Jensen Jacks and Pumping Units in the Composite Catalog.)

JENSEN BROTHERS MANUFACTURING COMPANY

Coffeyville, Kansas, U. S. A.

JENSEN JACKS

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GREEN SIGNIFIES SAFETY

ARE EASIER TO THREAD THROUGH THE TRAVELING BLOCK, CROWN BLOCK AND EYE IN DRUM

SPOOL TIGHTLY EVEN UNDER THE LIGHT WEIGHT OF IDLE BLOCK

WHIP LESS AT HIGH SPEED

RESIST KINKING AND REQUIRE NO SEIZING

LAST LONGER, THUS CUTTING DOWN REPLACEMENT, LABOR AND SHUT-DOWN COSTS

AMERICAN CABLE COMPANY, Inc.
Wilkes-Barre, Pennsylvania

•

Branches or Distributors in all Oil Field Centers

In Business for Your Safety

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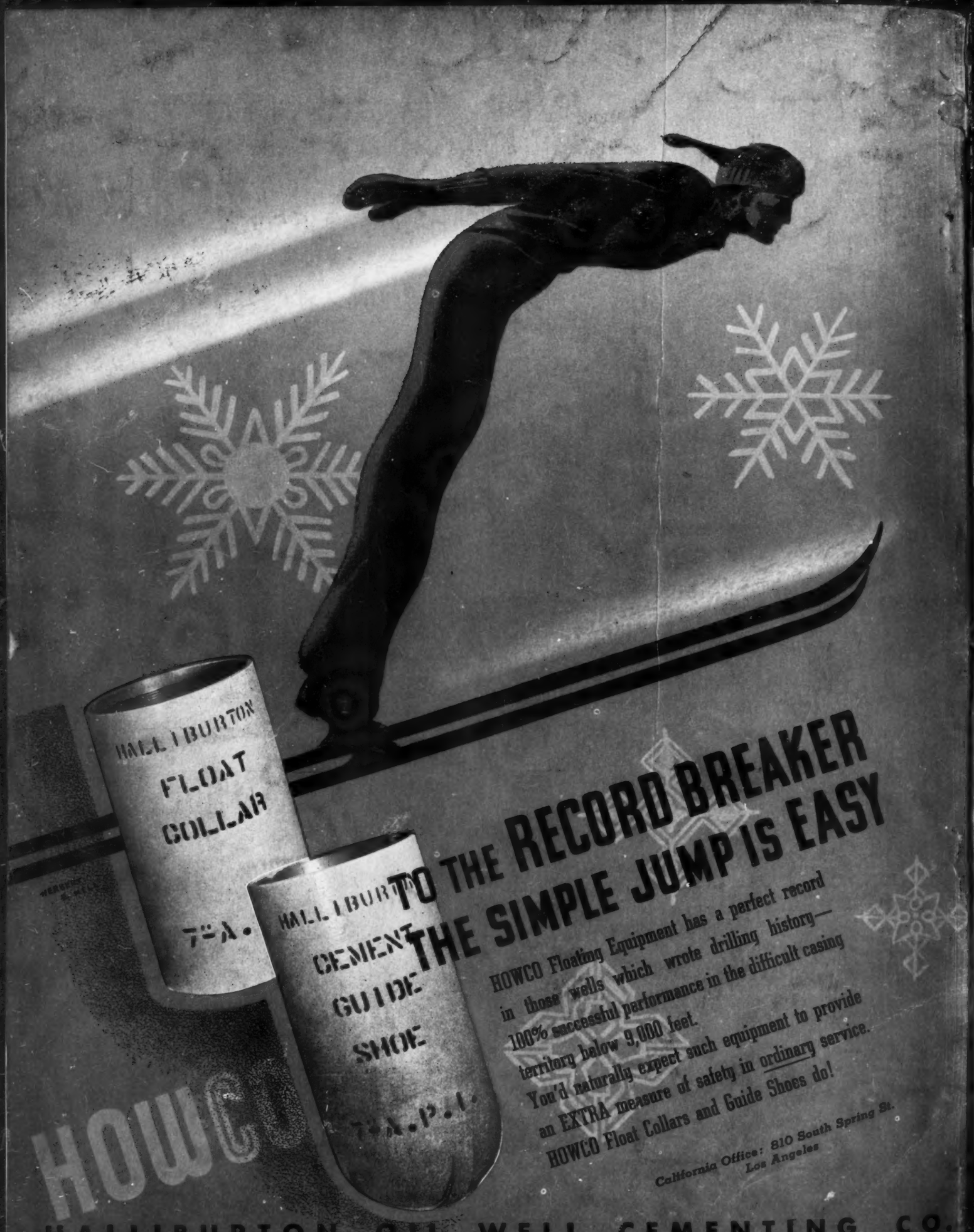
We compliment the Western Railroads on the Second Annual Railroad Week — July 13 - 18

•

TRU-LAY *Preformed* Rotary Lines

ALL AMERICAN CABLE COMPANY ROPES MADE OF IMPROVED PLOW STEEL ARE IDENTIFIED BY THE EMERALD STRAND



TO THE RECORD BREAKER THE SIMPLE JUMP IS EASY

HOWCO Floating Equipment has a perfect record in those wells which wrote drilling history—100% successful performance in the difficult casing territory below 9,000 feet.

You'd naturally expect such equipment to provide an EXTRA measure of safety in ordinary service. HOWCO Float Collars and Guide Shoes do!

California Office: 810 South Spring St. Los Angeles

HALLIBURTON OIL WELL CEMENTING CO.

DUNCAN, OKLAHOMA

MULTIPLE STAGE CEMENTING AT *Cayuga*

The CONDITIONS

● In a well at Cayuga, Texas: **1.** About 8,800 ft. of 7" O. D. casing was to be run. **2.** 4,100 ft. of 8¾" open hole. **3.** 9" O. D. casing set at 4,700 ft. **4.** A high-pressure gas sand was located in upper portion of open hole. **5.** Heavy circulating fluid was required to hold down high-pressure gas. **6.** A thirsty formation in open hole took ordinary mud and might take cement slurry. **7.** A thick circulating mud was used to lessen loss into thirsty formation. **8.** Temperature of circulating mud at overflow while drilling was 142° F.—highest on record; indicating highest temperature conditions in well ever to be encountered in a cementing job. **9.** Combination of thick, heavy drilling fluid caused a circulating pressure of 1,100 lbs. while drilling.

The PROBLEM

● The problem was to place cement behind the casing to protect any productive sand which might be located at the *bottom* of the well, and at the same time to protect the high-pressure gas sand in the *upper part* of the open hole. Because of the conditions it would be extremely difficult and impractical to place cement in a single stage to accomplish both objectives.

The SOLUTION

● A perfect solution to the problem was found in Multiple Stage Cementing. . . . . The casing was equipped with ONE HOWCO Guide Shoe, TWO HOWCO Float Collars and ONE HOWCO Multiple Stage Device set at a depth of 6,648 feet.

The RESULT

● *A 100% successful job*—Circulation was readily established after landing casing. Two stages of cement, 350 sacks each, were landed in their respective places behind casing in one continuous operation. Total elapsed time: *1 hour and 3 minutes.* Pump pressure never exceeded 1,000 lbs. Cement plugs, float valves and guide readily drilled out with 2½" upset tubing and 5⅞" rock bit. Well drilled to below 9,000 ft. . . . . no commercial production . . . . then plugged back inside casing to point below high-pressure gas sand which was protected by the second stage of cement. Casing was then perforated at gas sand and well completed as large gas well, making considerable distillate. Still producing.

SERIOUS PROBLEM *Successfully* SOLVED

HALLIBURTON OIL WELL CEMENTING CO.

DUNCAN, OKLAHOMA • CALIFORNIA OFFICE, 810 S. SPRING ST., LOS ANGELES

TRET-O-LITE

The standard of comparison wherever crude oil is treated to pipe line requirements.

TRETOLITE COMPANY

MANUFACTURING CHEMISTS

DALLAS **SAINT LOUIS** **LOS ANGELES**

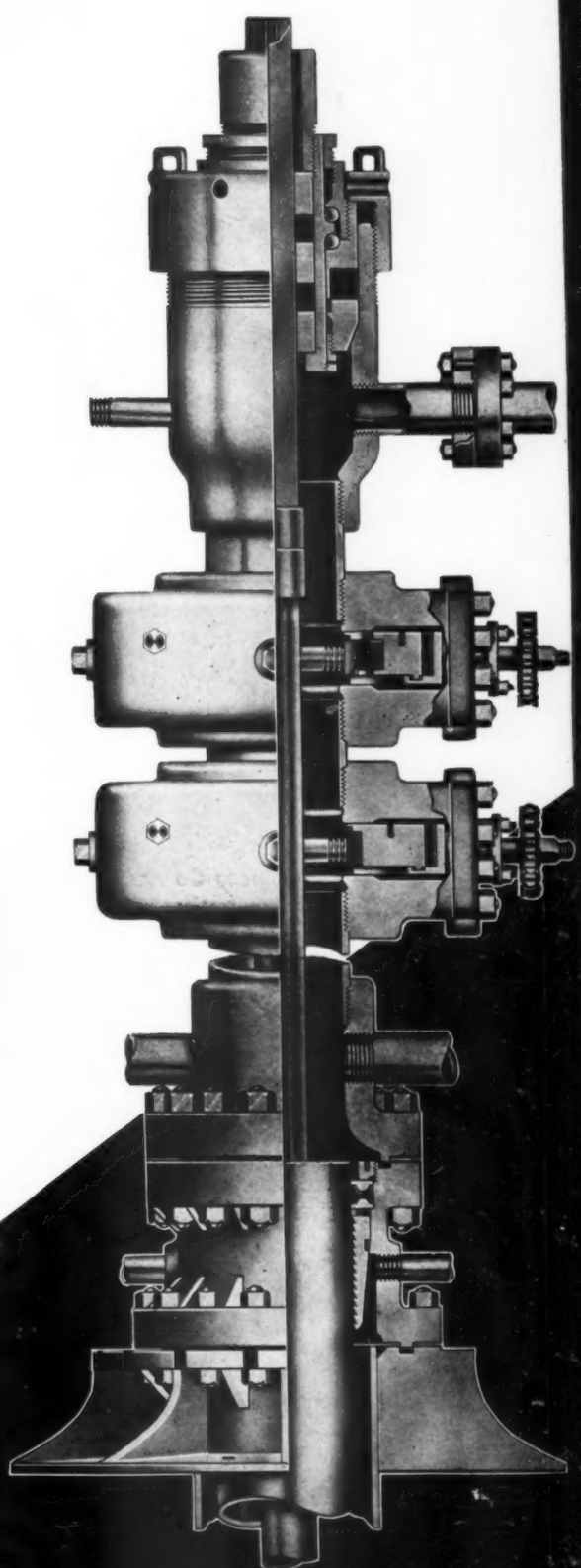
Representatives in all Principal Fields

"PRESSURE DRILLING"

IS SAFER WITH THIS COMPLETE HIGH PRESSURE HOOKUP . . .

For those operators who are depending on "pressure drilling" for bringing in better wells with higher potentials the Shaffer High Pressure Drilling Hook-up, as illustrated, offers complete well protection and control. In using the Shaffer Rotating Blowout Preventer drilling under pressure is accomplished with regular drilling equipment. In unexpectedly penetrating a high-pressure zone, when the pressure drilling method is used, the drill pipe or casing is easily and safely run in or pulled out under pressure with the use of the complete Shaffer High Pressure Drilling Hook-up. Two Shaffer Cellar Control Gates, one with rams to close around the drill pipe and the lower Gate with rams for complete shut-off, are always available. Both Gates may be provided with remote control for additional safety.

Shaffer High Pressure Safety Hook-Ups are manufactured for drilling and production of oil and gas wells for any pressure that may be encountered in modern drilling. Confer with us regarding your special problems. Definite recommendations will gladly be given.



SHAFFER TOOL WORKS

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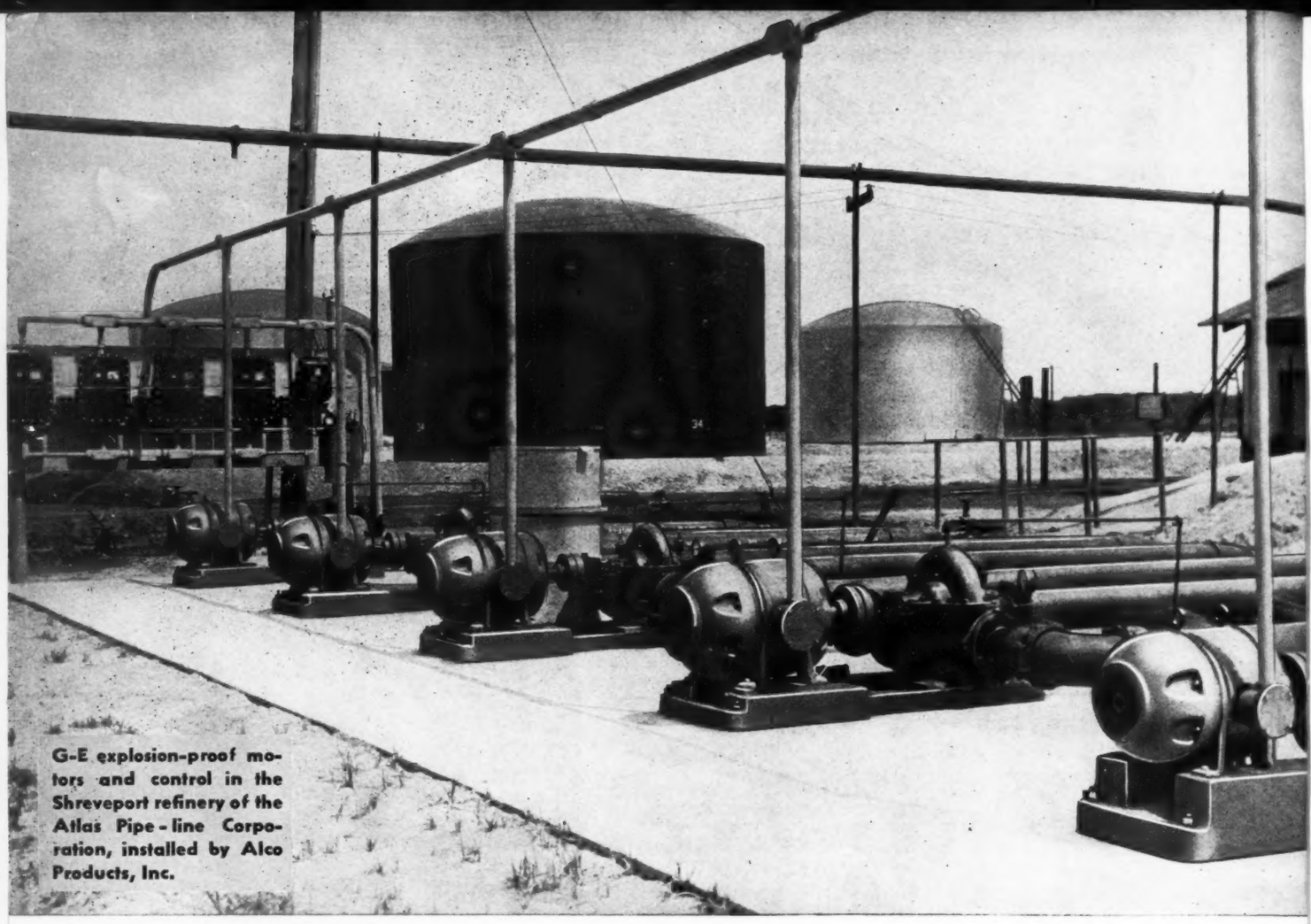
OKLAHOMA CITY, OKLA. **HOUSTON, TEXAS**

EXPORT: OIL WELL SUPPLY COMPANY

Specialists in
HIGH PRESSURE DRILLING AND CONTROL EQUIPMENT



G-E explosion-proof motors and control in the Shreveport refinery of the Atlas Pipe-line Corporation, installed by Alco Products, Inc.

Why General Electric Equipment Keeps Pumping Costs Low

Economical to Install

Special enclosures do not have to be built over G-E explosion-proof motors and control. These equipments are truly weatherproof, as shown by the installation pictured above.

Gives Maximum Protection for Employees

The G-E explosion-proof motor, with its dust-tight construction and cartridge-type ball-bearing housings with labyrinth seals, gives maximum protection. The control, too, is of explosion-proof design.

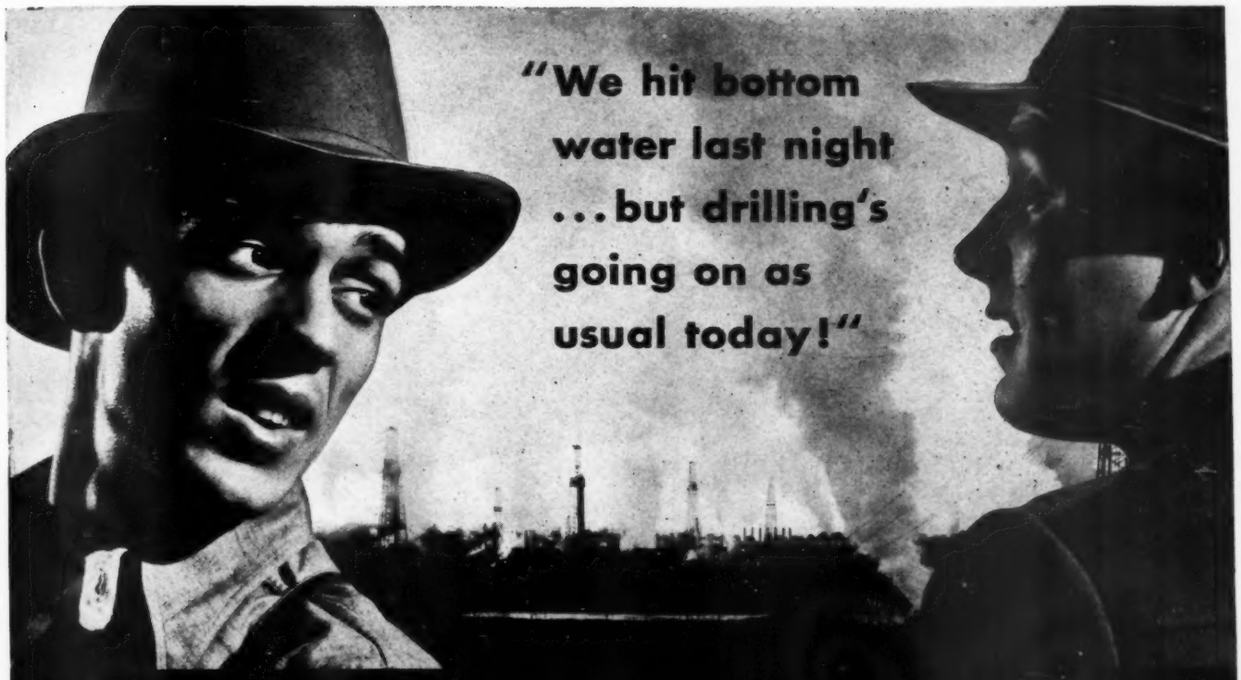
Tested by Underwriters' Laboratories

These G-E explosion-proof motors and starters are built to the standards of the Underwriters' Laboratories for service in Class I, Group D, hazardous gas locations. Each motor bears the Underwriters' label; the control is tested and listed by the Laboratories.

Whatever the job, we can supply the explosion-proof electric equipment for your refineries—motors of every type and size; control, from push-button stations to oil-immersed magnetic switches. General Electric, Schenectady, N. Y.

020-246A

GENERAL ELECTRIC



End costly shut-downs with

EAGLE LEAD WOOL

plugs off bottom water quickly!

Be sure you have Eagle Lead Wool ready when you need it.

Seals off water quickly, efficiently. Loose springy wool becomes solid plug under tamping pressure.

Seals tiniest cracks and crevices. Non-corrosive.

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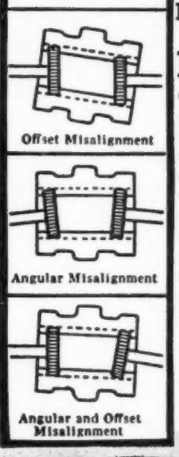
THE EAGLE-PICHER LEAD COMPANY, CINCINNATI, OHIO

The Petroleum Engineer, issued thirteen times a year by the Petroleum Engineer Publishing Co., 404-407 Tower Petroleum Bldg., Dallas, Texas. Subscription price, $2.00 per year, two years $3.00—25 cents a copy. Entered as second-class mail matter May 1, 1932, at the post office at Dallas, Texas, under the Act of March 3, 1879.

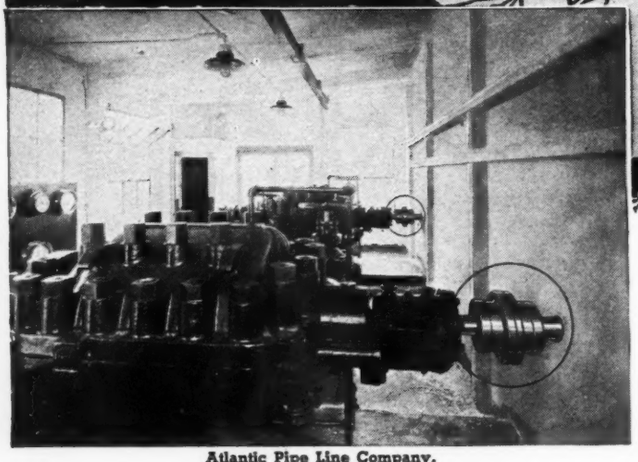
THEIR UNEQUALLED RECORD OF PERFORMANCE HAS PUT Fast's Couplings IN PUMPING STATIONS ALONG THOUSANDS OF MILES OF PIPELINE THROUGHOUT THE COUNTRY

Exaggerated Diagrams to Clearly Define Fast's Principle

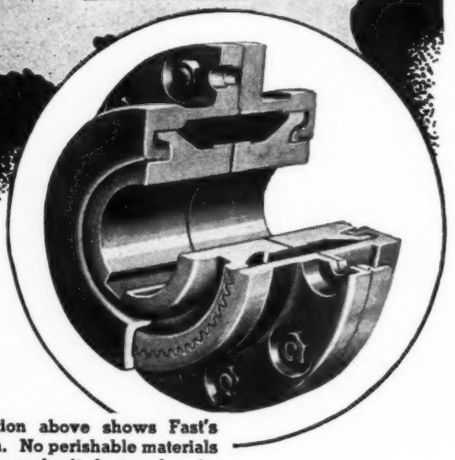


FAST'S PRINCIPLE MADE PLAIN

INSTALLING a Fast's Self-Aligning Coupling, in effect, places spur gears on the ends of the shafts that are to be connected. A floating sleeve with internal splines fits over these gears, meshing with them. As one shaft turns it rotates the sleeve and, of course, the other shaft — all operate as a unit. The floating sleeve forms a dust and moisture proof jacket that contains oil which prevents wear.



Atlantic Pipe Line Company, Midland, Texas



THE illustration above shows Fast's construction. No perishable materials are necessary to make it dust and moisture proof.

Great Lakes Pipe Line Company, Barnsdall, Oklahoma

FAST'S PATENTS COVER THESE VITAL FEATURES

FAST'S Self-Aligning Couplings have earned, during the fifteen years they have been on the market, an unmatched reputation for continuous, trouble-free operation.

The load-carrying surfaces are protected against wear by a positive film of oil. This oil is kept permanently clean by the rocking bearings which make precise metal-to-metal contact, forming dust and moisture proof seals. No perishable materials, springs, grids, etc., are used. There is nothing that needs periodical replacement.

You can secure continuous, dependable operation by specifying *genuine* Fast's Self-Aligning Couplings on the machinery you purchase.

THE BARTLETT HAYWARD COMPANY
BALTIMORE, MARYLAND

CASING IS ENDANGERED WITH WELDED TOOL JOINTS

unless

PATTERSON-BALLAGH PROTECTED

On a welded tool joint the ridges of the welding extend beyond the diameter of the tool joint and expose a ring of file-hard metal that actually mills the casing with which it comes in contact. Patterson-Ballagh Protectors are absolutely necessary on welded tool joints to prevent wear on casing. Patterson-Ballagh Protectors also reduce the pounding that tends to break joints in the well.

The use of Patterson-Ballagh Protectors really costs the operating company nothing, because the additional life of the drill pipe soon repays the installation cost.

INSTALL

PATTERSON-BALLAGH PROTECTORS

—the original all-rubber protection

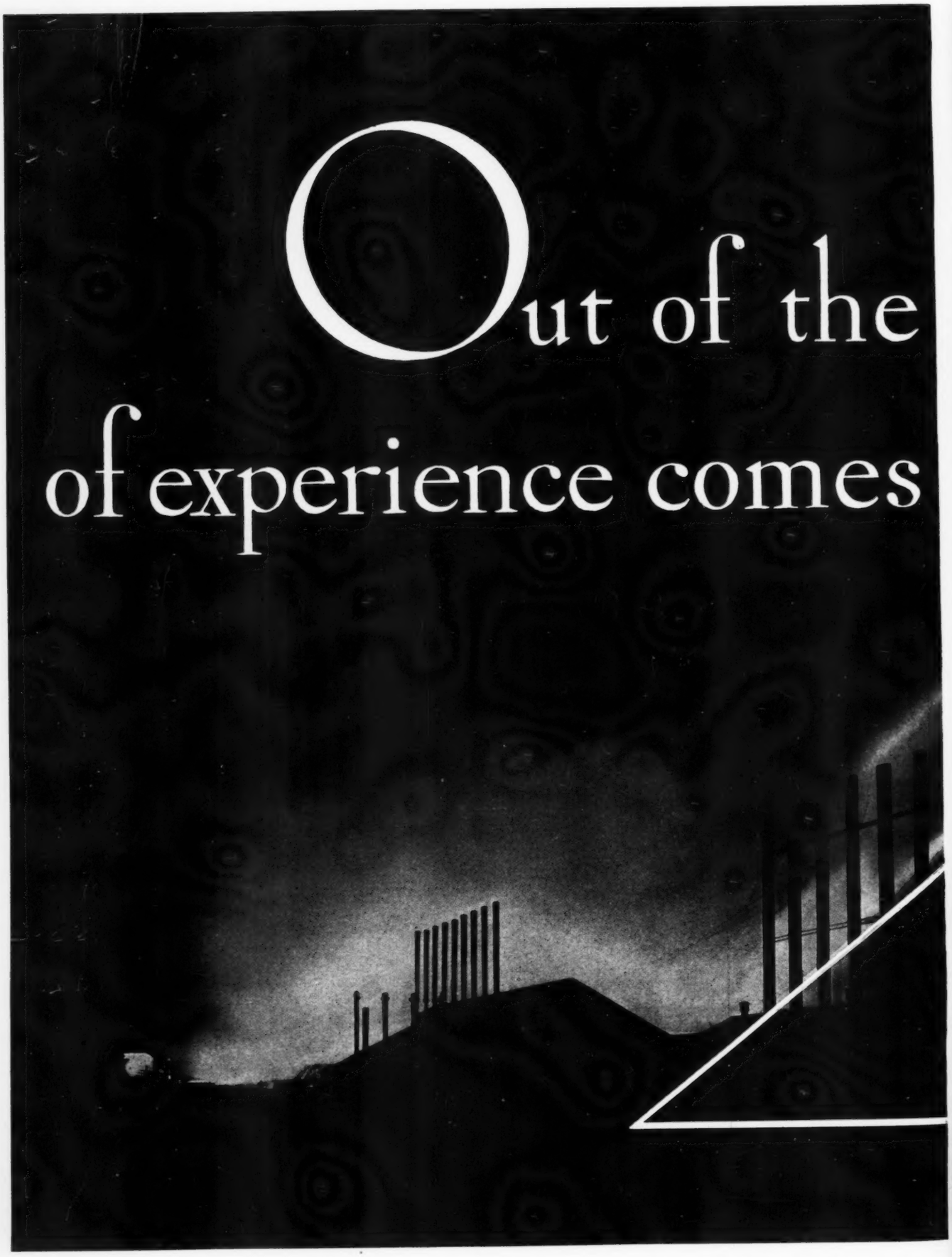
Photos of welded tool joints used in Oklahoma City field. Note unretouched photo to left, tool joints on two sections not equipped with Patterson-Ballagh Protectors worn smooth by contact with casing. The sections equipped with Protectors are not worn. Visible evidence!

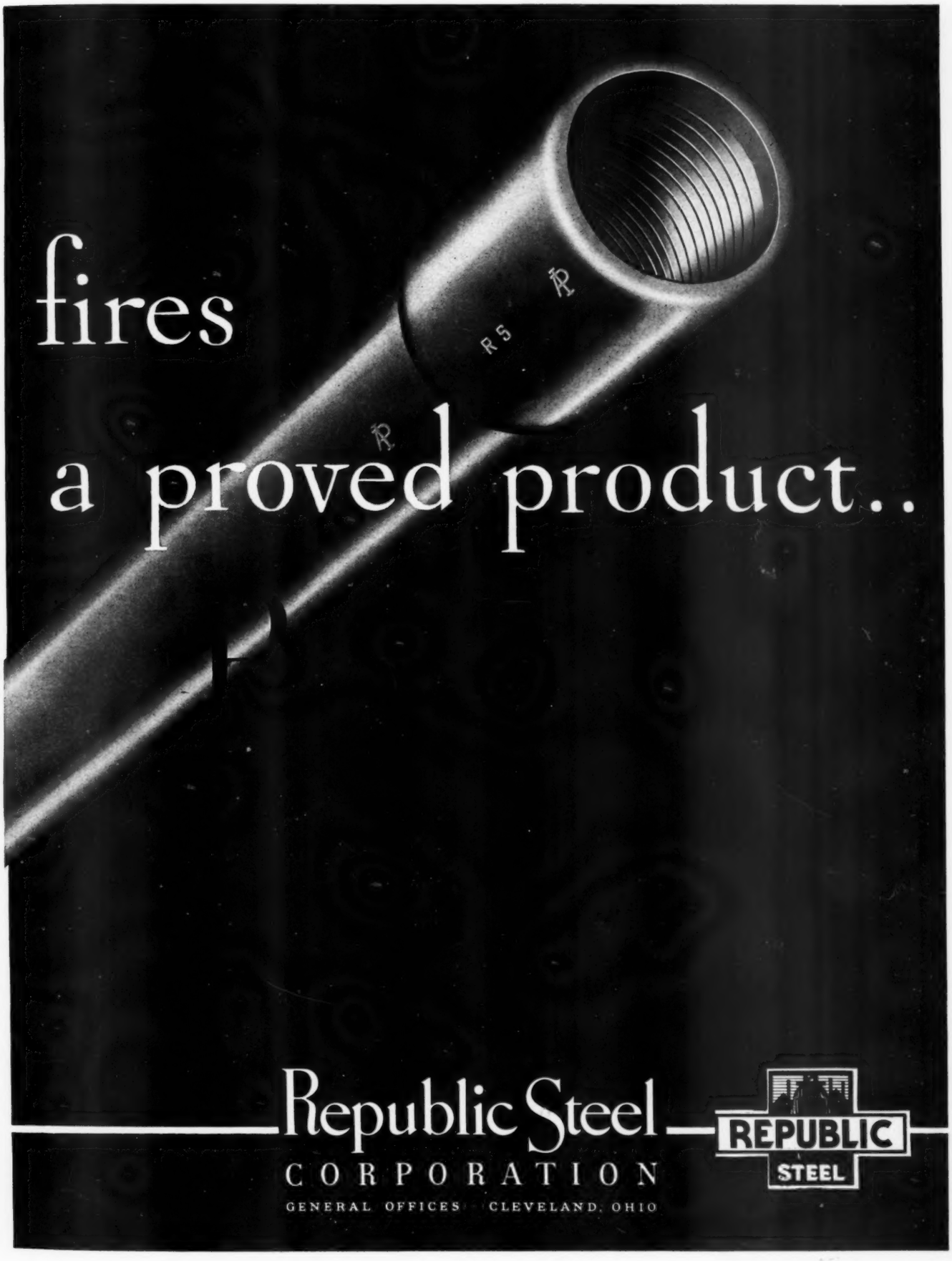
PATTERSON-BALLAGH CORPORATION

Plant and General Offices:
1900 East Sixty-fifth Street

Los Angeles, Calif., U. S. A.

New York Office: 39 Cortlandt Street; Oklahoma Office: Oklahoma City, 1704 N. W. 17th Street; Texas Office: Houston, 515 M. & M. Building; California Warehouse Stocks: Los Angeles, Kettleman Hills, Bakersfield, Ventura.


Out of the
of experience comes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